WATER WORKS & SEWERAGE

GILLETTE ABP ABC PUBLICATION

L. H. Enslow Editor

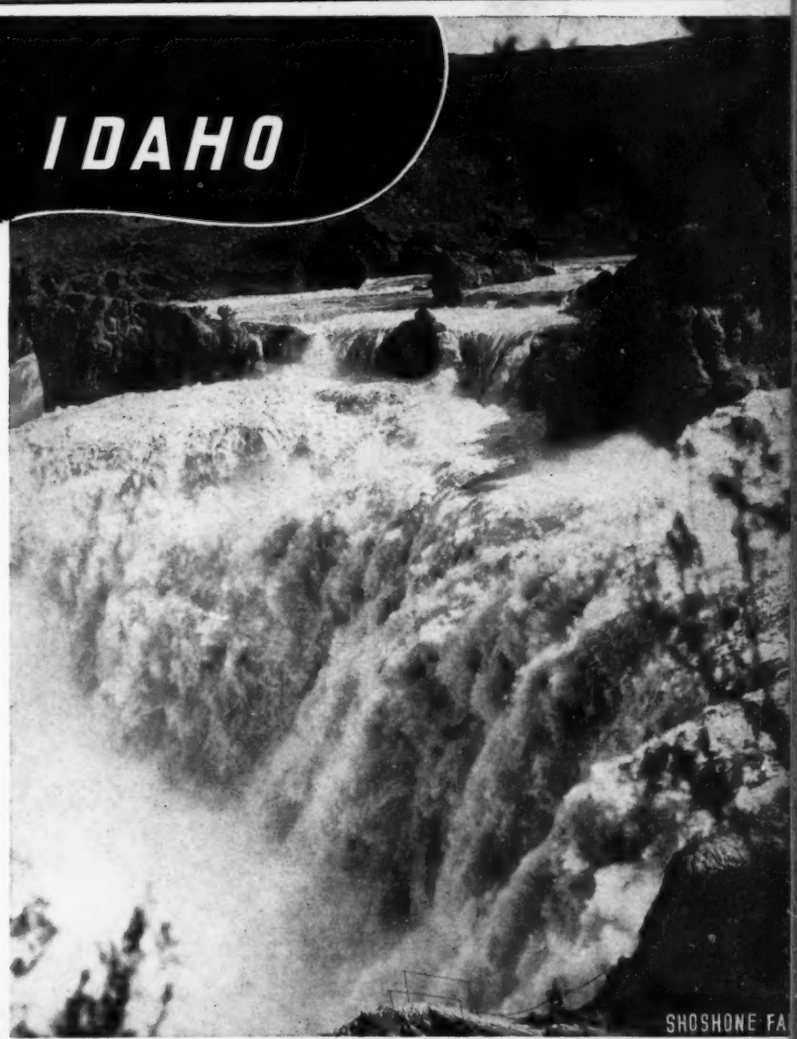
JANUARY, 1937
VOLUME 84. NO. 1

In TWIN FALLS IDAHO

Although the Idaho potato has gained national fame, the story of the opening and development of the Twin Falls tract appears almost like a myth to those unfamiliar with the actual latent possibilities of the fertile farm lands. In the short space of some thirty years a barren sagebrush desert has been conquered agriculturally and cities and towns, modern in every aspect, have been built.

The City of Twin Falls, Idaho, serves a trading area of 600,000 acres. The fact that more than 10,000 carloads of agricultural products are shipped from this district annually is proof of the productiveness of this fertile rich farm land.

A tribute to Pittsburgh Water Meters and the success of their 100% metered water supply is expressed by this statement from Mayor Johnston, "I have checked the use of meters with our various departments, such as Finance, Distribution, Filtration and Sewage, and the various heads of these departments all concur that it would be next to impossible to operate our Water System without the use of water meters."



PITTSBURGH EQUITABLE METER CO.

MERCO NORDSTROM VALVE CO.

MAIN OFFICES PITTSBURGH, PA.

NEW YORK	LOS ANGELES	TULSA	HOUSTON	MEMPHIS	BUFFALO
COLUMBIA	KANSAS CITY	CHICAGO	PHILADELPHIA	ATLANTA	OAKLAND

PITTSBURGH WATER METERS

WATCH THE TREND TO CAST IRON

Installation of 24-inch Super-de Lavaud Pipe for sewer construction by U. S. Army Engineers at Greenville, Miss.

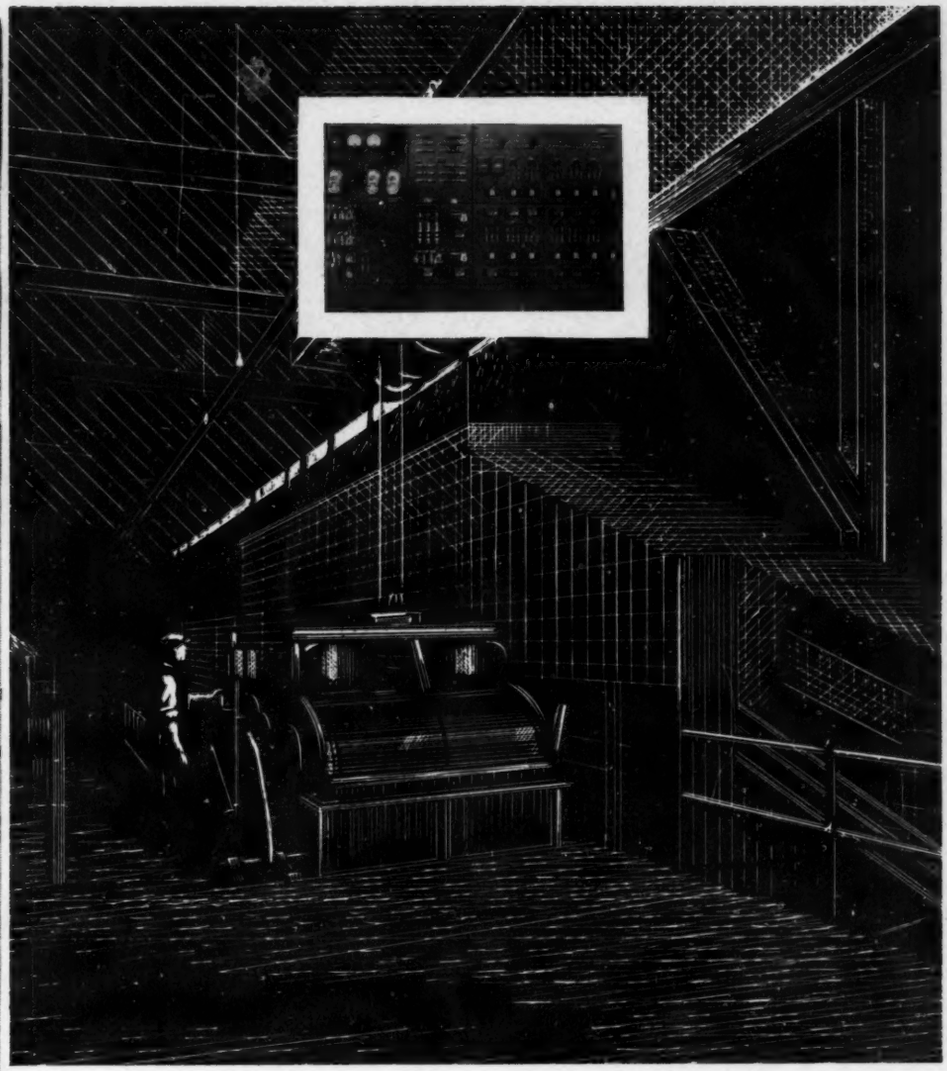
Prescription: for a trouble-proof, worry-free, permanent and economical sanitary sewer—cast iron pipe. *Reasons:* effective resistance to corrosion; great resistance to crushing loads; permanently tight joints; no infiltration; long life. *Cost:* least per year. *Service:* Our extensive facilities for the design, production and prompt shipment of pit cast and Super-de Lavaud centrifugally cast pipe and fittings for sanitary sewers, treatment and disposal plants. We carry stocks at 15 shipping points.

UNITED STATES PIPE AND FOUNDRY COMPANY
BURLINGTON NEW JERSEY

Foundries and Sales Offices throughout the United States

U. S. CAST IRON PIPE

for sewers and sewage treatment plants



Illustrated—Clark Control for Pumping Station Use

..Big LITTLE CONTROLS

Small in respect of size, but of great importance in point of the work they do, are Clark Controls, available in a wide range of types, sizes and applications. Small, they yet account for veritable batteries of heavy machinery . . . assist with major aspects of production. See if they do not prove a big factor in making your operations more profitable, reducing maintenance and promoting the standards you have set for the year of 1937.

★★ ★★

THE CLARK CONTROLLER COMPANY

1146 EAST 152nd STREET CLEVELAND, OHIO

WATER WORKS AND SEWERAGE, January, 1937, Volume 84, Number 1. Published monthly at 400 West Madison Street, Chicago, Ill., by the Gillette Publishing Company. Per copy, 25c. Subscription rate, $2.00 per year; Canadian and Foreign, $3.00 per year. Copy-

HOW TO HANDLE IT IF *IT* IS REMOVING FLOCCULENT SOLIDS

Why is the Rex Tow-Bro advancing so rapidly in its many fields of application?

● This new book will show you. It records the advance of the Rex Tow-Bro Clarifier since the first unit was installed 7 years ago. It shows its advance into new fields of water treatment and trade wastes recovery service, also its application to rectangular tanks, and to smaller round tanks. In sewage treatment plants 26 units are now in service, with an additional 4 in water treatment plants and 3 in trade wastes recovery service.

The book includes tests by sanitary, consulting and plant engineers that are startling in their record of efficiency.

It gives the reasons why the Tow-Bro Sludge Remover produces a more concentrated sludge, a clearer effluent and permits faster sludge removal—the basic advantages that lead to its continuing success.

Even if you are familiar with the Rex Tow-Bro Sludge Remover, this book will be valuable in its showing of new applications. Ask for the catalog, "The Rex Tow-Bro Sludge Remover." We want every engineer engaged in sanitation, trade wastes recovery, and water treatment to have one.

CHAIN BELT COMPANY
1610 West Bruce Street, Milwaukee, Wisconsin

REX

CHAIN BELT COMPANY
of MILWAUKEE

Sanitation Equipment

PLEASURE . . .

OLD MAN WINTER is now in his glory furnishing all and sundry with a variety of pleasures.

Those more fortunate souls who may pick their weather by going to warmer climes are enjoying the pleasures of summer sports such as depicted in the beach scene above. Less fortunate souls can still derive pleasure in colder climes by sled riding, skiing, or just enjoying the varied winter scenery particularly by sunlight or moonlight.

From our many friends in the water works field, we realize that their greatest pleasures are derived from surmounting difficulties which Old Man Winter thrusts upon them. It is true that colder weather in many cases eliminates completely all taste and odor troubles, but all operators are not so fortunate.

Stream flows at this time of year are smaller than usual, thus accentuating pollution troubles, because of the low dilution factor. Sewage, and trade waste contamination can be particularly troublesome under such conditions. Algae troubles, although considerably minimized, are still present occasionally, and may cause difficulty, particularly if reservoirs are frozen over. Snow often gives a characteristic flavor to water, necessitating treatment. The water works fraternity derive pleasure from the fact that they can overcome these and other difficulties with POWDERED AQUA NUCHAR.

We derive pleasure from supplying AQUA NUCHAR to the water works field, and in being able to make prompt deliveries to any plants having unanticipated taste and odor difficulties.

E. A. SIGWORTH
Technical Sales Staff

"MAKE YOUR PLANS NOW TO ATTEND THE 57TH ANNUAL CONVENTION OF THE AMERICAN WATER WORKS ASSOCIATION TO BE HELD JUNE 7-11, 1937, AT THE HOTEL STATLER, BUFFALO, NEW YORK."

INDUSTRIAL CHEMICAL SALES
DIVISION WEST VIRGINIA PULP and PAPER CO.
230 PARK AVENUE **NEW YORK CITY**

HERE IT IS! BUILT FOR WATERWORKS ENGINEERS

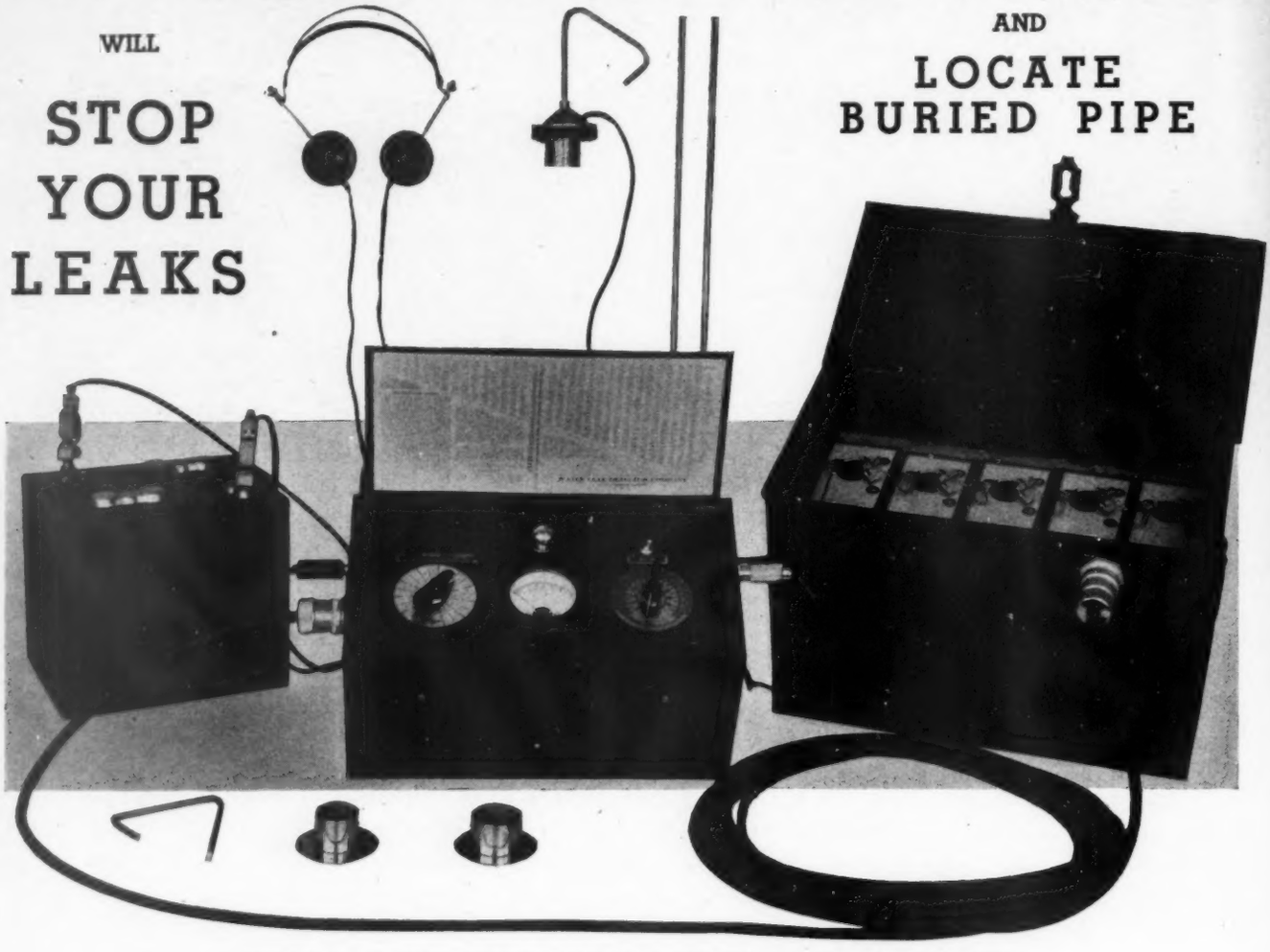
"UNIVERSAL" WATER LEAK DETECTOR

WILL

STOP YOUR LEAKS

AND

LOCATE BURIED PIPE



HERE IS A SCIENTIFICALLY DESIGNED AND PROVEN

WATER LEAK DETECTOR

which embodies in its construction the recently discovered principles of controlled, filtered and measured sound.

Leak vibrations are measured on the UNIVERSAL'S recording meter and the determinations are reached on the control dial to within ten 1,000ths amplitude! Think of it! Even the smallest of leaks can now be positively detected!

The UNIVERSAL put the engineering miracle of water-leak detection in the exact science class, based upon mathematical calculations. With the human ear ruled out as a factor of detection, a deaf man can now locate leaks in any water system—with the UNIVERSAL WATER LEAK DETECTOR. "Remove the human element," water works engineers have pleaded, "so we can be sure of leaks and then we can remove the large losses we're now experiencing in our distribution systems." So with the development of radio, talking pictures and MEASURED SOUND, research engineers designed and perfected the UNIVERSAL. This instrument is simple to operate. Just place the microphone with rod attached on exposed parts of the underground distribution system. If the meter remains at zero, then no leaks are in the immediate vicinity. But if the meter moves a few points, then it is an indication that a leak is near. By moving the microphone and instrument either forward or backward, the meter reading will increase or decrease, showing that the operator is going towards or away from the leak.

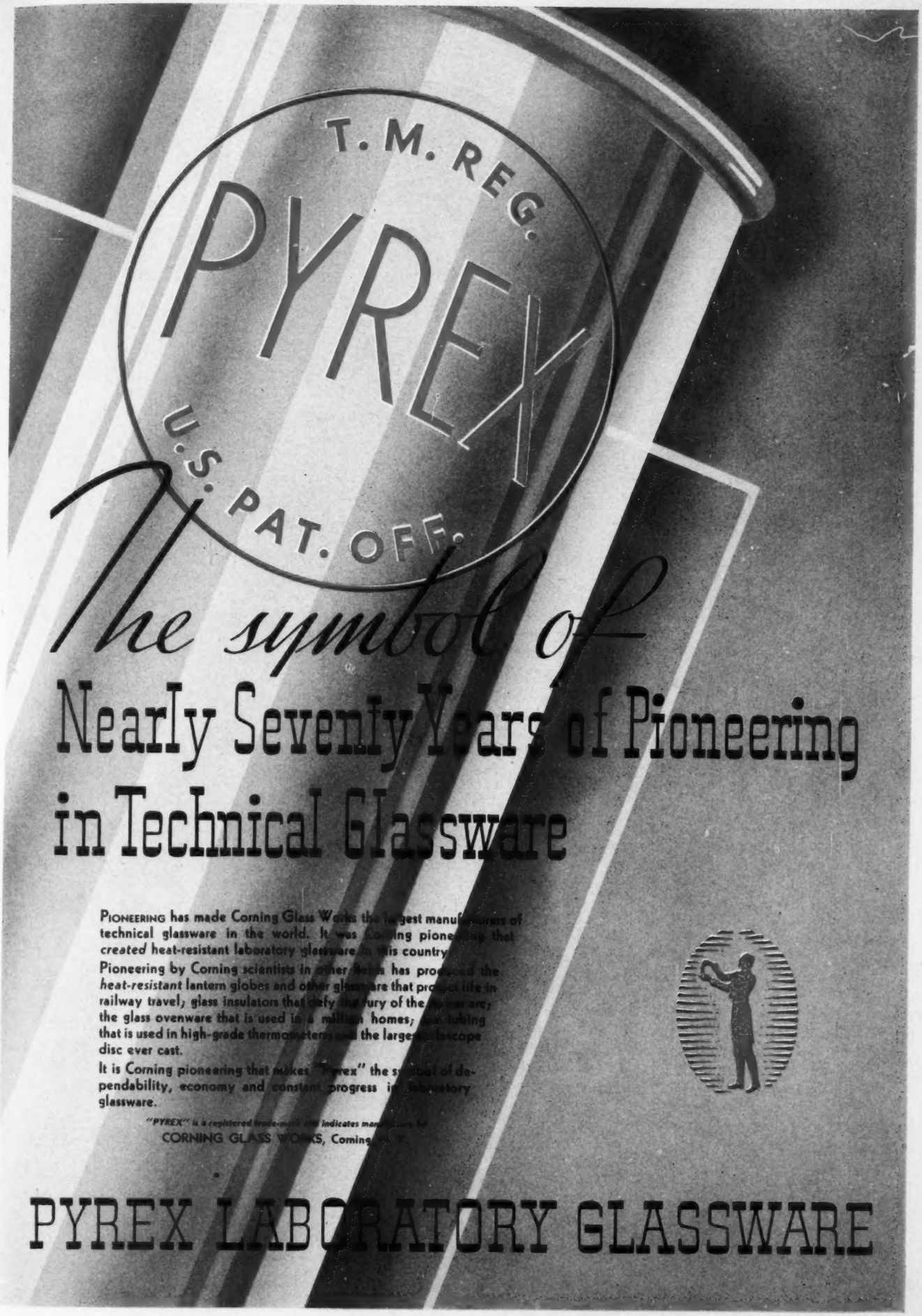
MADE IN THREE SIZES

UNIVERSAL JUNIOR — LIGHT DUTY — HEAVY DUTY

Write for Our New Booklet, "The Answer to Your Water Leak Problems"

WATER LEAK DETECTOR COMPANY

155 N. THIRD STREET — COLUMBUS, OHIO


T. M. REG.
PYREX
U.S. PAT. OFF.
The symbol of
Nearly Seventy Years of Pioneering
in Technical Glassware
PIONEERING has made Corning Glass Works the largest manufacturers of technical glassware in the world. It was Corning pioneering that created heat-resistant laboratory glassware in this country.
Pioneering by Corning scientists in other fields has produced the heat-resistant lantern globes and other glassware that protect life in railway travel; glass insulators that defy the fury of the power arc; the glass ovenware that is used in a million homes; the tubing that is used in high-grade thermometers; and the largest telescope disc ever cast.
It is Corning pioneering that makes "Pyrex" the symbol of dependability, economy and constant progress in laboratory glassware.
"PYREX" is a registered trade-mark and indicates manufacture by
CORNING GLASS WORKS, Corning, N. Y.
PYREX LABORATORY GLASSWARE

Serves the Public Works Field

PERS

Few people have any conception of the many ways in which Koppers serves the public works field.

Koppers is one of the important sources of road tars, and supplies millions of gallons of Tarmac to cities, townships, counties and states.

It operates great wood-treating and wood-working plants where lumber is cut to size, adzed, bored and treated with creosote or other preservative materials for bridges, culverts, guard rails, posts, poles and for structural purposes.

It designs and builds the type of incinerator furnaces used in the majority of the larger municipalities in America, and it has helped to save thousands of dollars by generating electricity from the steam produced.

It is the only company producing Fast's self-aligning Couplings which are widely used for power shaft connections.

Koppers manufactures gate valves for water works and water distribution systems and equipment for sewage disposal plants. It makes some of the largest bronze castings produced in this country. It built the gates for the Norris, Wheeler and Fort Peck dams, and many smaller ones. It makes tunnel liners and other gray iron castings.

It designs and builds complete gas-producing plants, and gas holders. It has developed an improved type of fire hydrant.

It produces disinfectants, insecticides, weed-killers, deodorizers, paints and scores of other products.

KOPPERS COMPANY
PITTSBURGH · PA.

KOPPERS
DIVISIONS

American Hammered Piston Ring Division

Bartlett Hayward Division

Engineering and Construction Division

Gas and Coke Division

Tar and Chemical Division

Western Gas Division

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SUBSIDIARIES AND AFFILIATES

Eastern Gas and Fuel Associates

Hiler Engineering and Construction Company, Inc.

The Koppers Coal Company

Koppers-Rheolaveur Company

The Maryland Drydock Company

The White Tar Company of New Jersey, Inc.

The Wood Preserving Corporation

ELEVATED STORAGE

. . . simplifies water supply problem for Virginia community

ORDINARILY, large capacity elevated storage tanks are installed by waterworks departments as an improvement for an existing water supply system. At Madison Heights, Virginia, however, this order was somewhat reversed, in that a large elevated tank was made to serve as the key for an entirely new system. The way in which this came about may be of interest to other communities faced with a similar problem.

In recent years, Madison Heights has offered attractive possibilities as a residential community for business people from Lynchburg directly across the river; but, unfortunately, modern water supply facilities were lacking. To correct this need, the Madison Heights Sanitary District Board proposed to build a complete plant with all the usual features. Before this was undertaken, however, further study revealed that a more economical plan would be to purchase water from the city of Lynchburg.

As designed and constructed under the supervision of E. E. Barnard, Consulting Engineer, the new Madison Heights system is as simple as it is effective. Water is carried across the James River from Lynchburg by a 12-inch main . . . through a meter . . . into a gridiron system of distribution mains . . . and on across to the far side of town, where the 250,000 gal. tank pictured above is located. Thus, the district enjoys dual flow during peak periods—from the tank and from the incoming supply. The only additional equipment required for the system was a pair of 300 g.p.m. booster pumps which operate when needed to keep the tank filled.

The tank is of the Horton radial-cone bottom design which has made practical and economical capacities of 2,000,000 gal. or more with range of head not exceeding 25 ft.

We will be glad to furnish additional information on this and other similar projects to readers interested in possible improvements for their own cities. We are also always glad to furnish quotations on all kinds of tanks, reservoirs, penstocks, pipe, smoke stacks, standpipes, and other types of welded or riveted plate work. Address our nearest office.

CHICAGO BRIDGE & IRON COMPANY

Chicago . . . . . 2198 Old Colony Bldg.
New York . 3390-165 Broadway Bldg.
Cleveland . . . . 2262 Rockefeller Bldg.
Dallas . 1479 Dallas Athletic Club Bldg.
Birmingham . . . 1586 North 50th St.
Tulsa . . . . . 1646 Hunt Bldg.
Houston . . . . . 2919 Main St.
Detroit . . . . . 1551 Lafayette Bldg.
Philadelphia . . 1644-1700 Walnut St.
Boston . 1548 Consolidated Gas Bldg.
San Francisco 1083 Rialto Bldg.
Los Angeles . . . . 1455 Wm. Fox Bldg.

Fabricating plants in CHICAGO, BIRMINGHAM, and GREENVILLE, PA.

EBG COMES CLEAN...GASEOUS CONTENTS REMOVED...*When cylinders, drums or tank cars are returned to EBG they are checked and the remaining gas removed. It is the first step in the careful process of making EBG containers spotlessly clean. Next comes valve removal, inspection and reconditioning, followed by an internal inspection with a special light. Cylinders are washed, dried, brushed, scraped and, if necessary, painted. Before and after filling, weight is rechecked, valve reinspected and every precaution taken to insure perfect closure and ease of operation. EBG Liquid Chlorine is pure...and it "comes clean".*

•

ELECTRO BLEACHING GAS COMPANY
MAIN OFFICE: 60 EAST 42nd STREET, NEW YORK, N. Y.
Plant: Niagara Falls, N. Y.

EBG Liquid Chlorine
FIRST IN THE COUNTRY

11 SELECT BURNING AS THE ONLY METHOD OF COMPLETE SEWAGE SLUDGE DISPOSAL

REALIZING the need for a satisfactory and economical solution of sewage sludge disposal problems, the municipalities shown on the map above have contracted for installation of Nichols Herreshoff Sewage Sludge Incinerators. They have followed the lead of the West Side Plant at Dearborn, Michigan, which has been benefiting for the past two years by this modern and economical method of sludge disposal. Numerous other cities and towns throughout the country have installation of incinerators under advisement. The introduction of this equipment has marked a significant phase in municipal sanitation.

The burning of sewage sludge as accomplished by this system destroys bacteria and organic matter, leaving only a fine, clean ash—in sharp contrast to the unsanitary sludge pile. Years of intensive research and development have made the dream of satisfactory disposal become a reality.

This organization is prepared to render an unusual service to engineers and public officials interested in solving municipal waste disposal problems.

NICHOLS HERRESHOFF SEWAGE SLUDGE INCINERATOR

NICHOLS ENGINEERING & RESEARCH CORP.
40 WALL STREET, NEW YORK

PACIFIC FOUNDRY CO., LTD.
3100 NINETEENTH STREET, SAN FRANCISCO

MOUNT COLUMBIA • CANADA

PURITY

COLUMBIA
LIQUID CHLORINE
(In Single and Multiple Unit Tank Cars, 100 and 150 lb. Cylinders.)

Other COLUMBIA Products

SODA ASH
CAUSTIC SODA
SODIUM BICARBONATE
MODIFIED SODAS
CALCIUM CHLORIDE

ETERNAL SNOW crowns the summit of Mount Columbia, Queen of the Canadian Rockies. • From the plant of another Columbia, . . . THE COLUMBIA ALKALI CORPORATION, . . . comes a man-made product which vies with Nature for purity. • Specify COLUMBIA Liquid Chlorine for a Happy New Year.

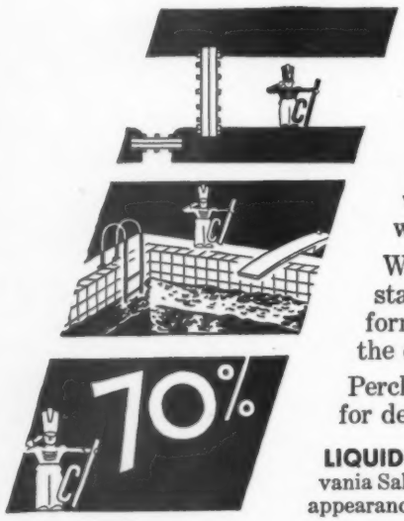
Send for new folder on COLUMBIA Liquid Chlorine.

THE COLUMBIA ALKALI CORPORATION

EXECUTIVE SALES OFFICES 30 ROCKEFELLER PLAZA • NEW YORK, N. Y.
Branch Sales Offices • BARBERTON, OHIO • 431-451 ST. CLAIR STREET, CHICAGO
CAREW TOWER, CINCINNATI • GRANT BLDG., PITTSBURGH • Plant at Barberton, Ohio

Perchloron

dependable in emergencies



Emergencies that might endanger the water supply cannot be foreseen — but they can be guarded against. A supply of Perchloron is a standby source of chlorine that is always instantly available.

For this reason alone, there is safety in keeping Perchloron on hand. But it is valuable also in many routine services. It is a highly convenient, concentrated source of chlorine for sterilizing new mains as well as clear wells and filters. And it is widely used to purify the water of swimming pools.

With an available chlorine content of more than 70%, Perchloron is stable and concentrated. Dissolves immediately in water. Perfectly uniform, simplifying technical supervision. Packed 12 handy-sized cans to the case—no return containers to bother with.

Perchloron is economical—why not keep an ample supply on hand ? Write for descriptive literature today.

LIQUID CHLORINE — You are assured of high purity in the chlorine produced by Pennsylvania Salt Manufacturing Company. It will be supplied in cylinders of exceptionally pleasing appearance as rapidly as they can be repainted. Watch for these attractive cylinders.

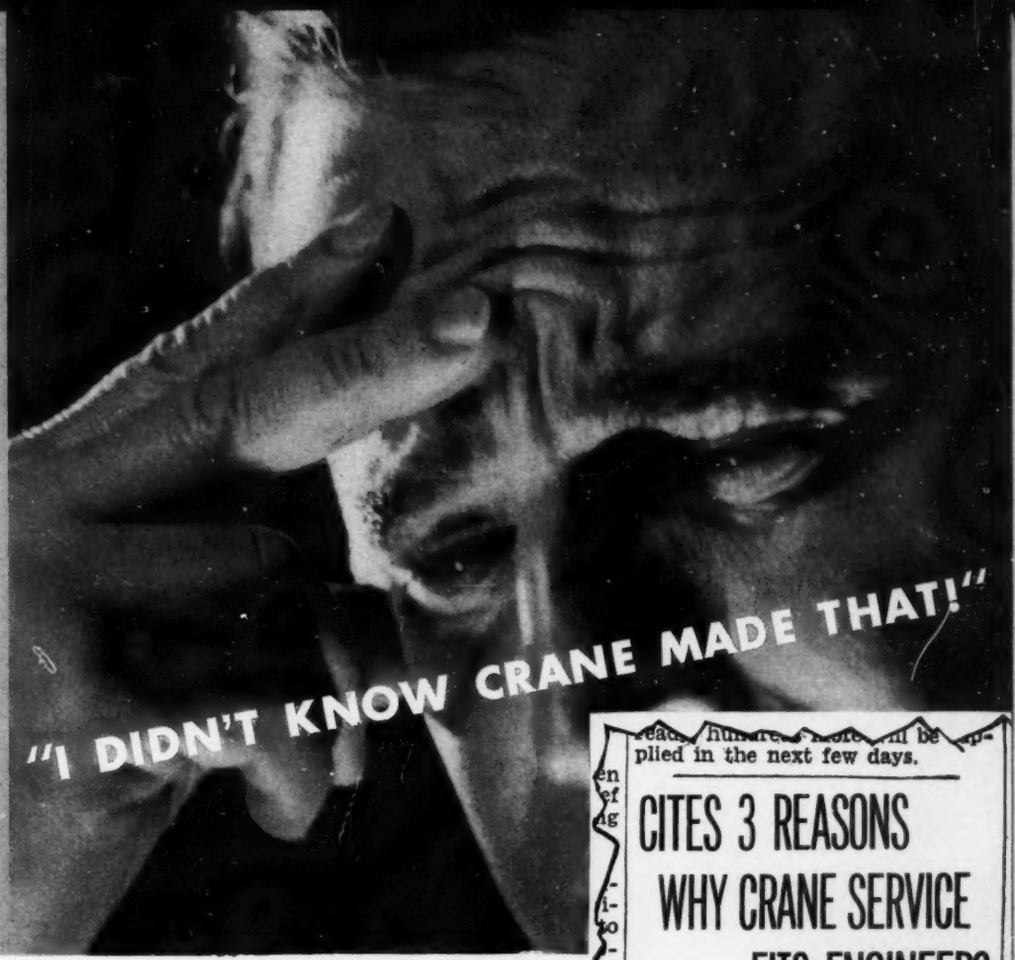
EST. 1850 TRADE MARK

PENNSYLVANIA
SALT MANUFACTURING COMPANY

EXECUTIVE OFFICES, WIDENER BLDG., PHILADELPHIA, PA.

BRANCH SALES OFFICES: NEW YORK · CHICAGO · ST. LOUIS · PITTSBURGH · TACOMA · WYANDOTTE

Rx Remedies FOR NEW KINDS OF "HEADACHES"



The young engineer was worried by a problem that was new to him. He had come to Crane for help. He thought he had to have a "special" valve to fit his conditions. He didn't think anyone had ever made exactly the thing he needed. Could we cure what he called "a new kind of headache"?

It took only a few minutes to find the answer—a standard Crane valve.

Of course, solving valve problems isn't always so easy. Every once in a while someone, somewhere, finds a new way to torture a valve. That calls for special research. But for most "new" valve problems Crane has solutions, proved and ready for use.

The Crane No. 52 Catalog contains 764 pages of useful information for valve users—3,400 illustrations—38,000 items and dimensions. It presents the world's largest and most complete line of valves and fittings, tested in the laboratory and on the job.

Use your Crane Catalog whenever you need valves, fittings, pipe or accessories.

CranEquip for satisfaction.

CRANE

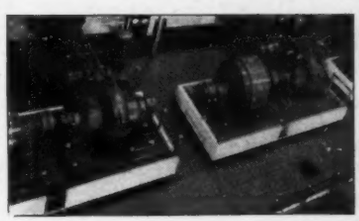
CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVENUE, CHICAGO, ILL.

Branches and Sales Offices in One Hundred and Sixty Cities

VALVES, FITTINGS, FABRICATED PIPE, PUMPS, HEATING AND PLUMBING MATERIAL

plied in the next few days.

CITES 3 REASONS WHY CRANE SERVICE FITS ENGINEERS



CHICAGO, ILL., Dec. 17—There are three main reasons why Crane Co. is able to give unparalleled service to engineers who deal with waterworks, filtration plants, sewage disposal plants or irrigation projects.

The first reason that Crane service fits engineering requirements so well is that Crane covers more territory more adequately than does any other company of its kind. There is a nation-wide network of approximately 600 Crane distributors and branches with stocks of standard valves and fittings.

The second reason is the completeness of the Crane valve, fitting, pipe and accessory line. Crane supplies valves from ½-inch service line shutoffs to 120-inch motor-operated monsters—from random lengths of pipe to complicated pipe fabrications.

Single Source Valuable

Third, the engineer who CranEquips his project has the advantage of dealing with a single, responsible, adequate source. This makes meeting speedy construction schedules easier. It also insures that routine maintenance wants will be readily filled, low inventories can be carried and service problems are simple.

THE SURVIVAL

SIX YEARS ago the Gillette Publishing Company first issued a magazine under a new name, fittingly called WATER WORKS AND SEWERAGE, to be devoted exclusively to the water works and sewerage fields.

Today after 6 years spent in overcoming many obstacles WATER WORKS AND SEWERAGE comes through with flying colors.

The superiority of WATER WORKS AND SEWERAGE is more than just a matter of opinion. This is proven by the fact that from 1933 to 1936 we have shown a record *gain of 228%* in advertising volume! 52 new advertisers in 1936.

Under the able direction of its editor, Linn H. Enslow, WATER WORKS AND SEWERAGE has constantly met the growing demands for improved and outstanding editorial matter—this, together with its quality circulation, and high reader interest, ranks WATER WORKS AND SEWERAGE "TOPS" in the minds of its ever-growing list of advertisers.

● To the following 52 *new* advertisers who contracted for space during 1936 we extend our sincere thanks. They, like many others, have found that advertising in WATER WORKS AND SEWERAGE—pays.

Activated Alum Corporation
Aluminum Co. of America
American Centrifugal Corp.
American Rolling Mill Co., The
Armco Culvert Mfgrs. Assn.
Automatic Primer Co.
Bailey Meter Co.
Barber Green Co.
Blaw Knox Co.
Bowen Research Corp.
Clark Controller Co., The
Champion Corp.
Chicago Bridge and Iron Co.
Chicago Rawhide Co.
Cliffs Dow Chemical Co.
Cloroben Corp., The
Columbia Alkali Corp., The
Columbia Construction Co.
Cooper Bessemer Corp., The
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Graver Tank & Mfg. Co., Inc.
Gruendler Crusher & Pulverizer Co.
Hills McCanna Co.
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Johns-Manville Co.
Layne & Bowler Inc.
McWane Cast Iron Pipe Co.
Merrimac Chemical Co.
Monsanto Chemical Co.
Nichols Engr. & Research Corp.
Norton Co.
Novo Engine Co.
Pacific States Cast Iron Pipe Co.
Pittsburgh Equitable Meter Co.
Reeves Pulley Co.
S. Morgan Smith Co.
Sparling Co., R. W.
Syntron Co.
Templeton-Kenly & Co.
Victor Equipment Company
Wilkens-Anderson Co.
Wilson Chemical Feeder Inc.
Worthington Pump & Machinery Co.

● To the following *old* friends we extend our appreciation for their continued support — and in many cases increased schedules during 1936.

American Brass Company
American Cast Iron Pipe Co.
American Gas Products
Anaconda Copper & Brass Co.
Arrowhead Iron Works
Atlas Mineral Products Co.
Builders Iron Foundry Co.
Brainard & Hatch
Carborundum Company
Cast Iron Pipe Research Assn.
Chain Belt Co.
Chicago Pump Co.
Columbian Iron Works
Crane Co.
Dorr Co. Inc., The
Dresser Mfg. Co. S. R.,
Edson Corp., The
Electro Bleaching Gas Co.
Everson Filter Co.
Filclor Co., The
Filtration Equipment Corp.
Fuller & McClintock
Great Western Electro-Chemical Co.
Hellige, Inc.
Hill, Nicholas S. Jr.
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Hydraulic Development Corp.
Industrial Chemical Sales Co.
International Filter Co.
Jeffrey Mfg. Co.
LaMotte Chemical Products Co.
Lock Joint Pipe Co.
Ludlow Valve Company
Lynchburg Foundry Co.
Link Belt Company
Mathieson Alkali Works, The
Mueller Co.
Municipal Sanitary Service Corp.
National Water Main Cleaning Co.
Oliver United Filters, Inc.
Pacific Flush Tank Co.
Permutit Company
Pennsylvania Salt Mfg. Co.
Phipps & Bird, Inc.
Pittsburgh Des Moines Steel Co.
Pittsburgh Steel Company
Proportioneers, Inc.
Portland Cement Assn.
Roberts Filter Mfg. Co.
Royer Foundry & Mach. Co.
Servicised Products Co.
Sika, Inc.
Simplex Valve & Meter Co.
Sonken Galamba Corp.
South Bend Foundry Co.
Stewart Iron Works Co. Inc.
Taylor, W. A. Co.
U. S. Pipe & Foundry Co.
Vogt Mfg. Co., Inc.
Wallace & Tiernan, Inc.
Whitman & Howard
Wood, R. D. Co.
Wykoff & Sons Co., A.

WATER WORKS

MEMBER AUDIT BUREAU OF CIRCULATIONS

The No. 1 MAGAZINE

OF THE FITTEST

A Record Making Year!

1936
361 PAGES

♦

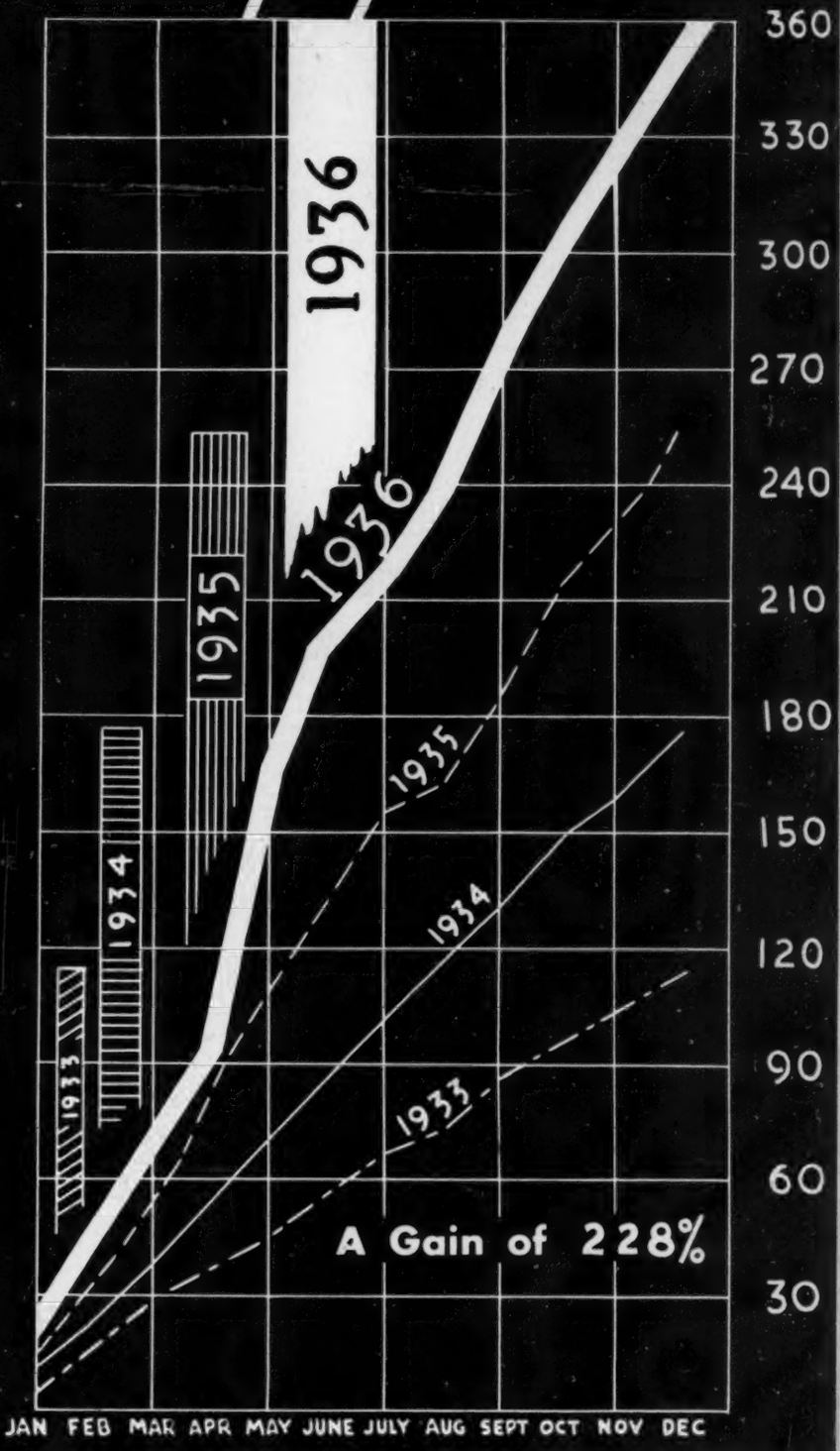
1935
249 PAGES

♦

1934
175 PAGES

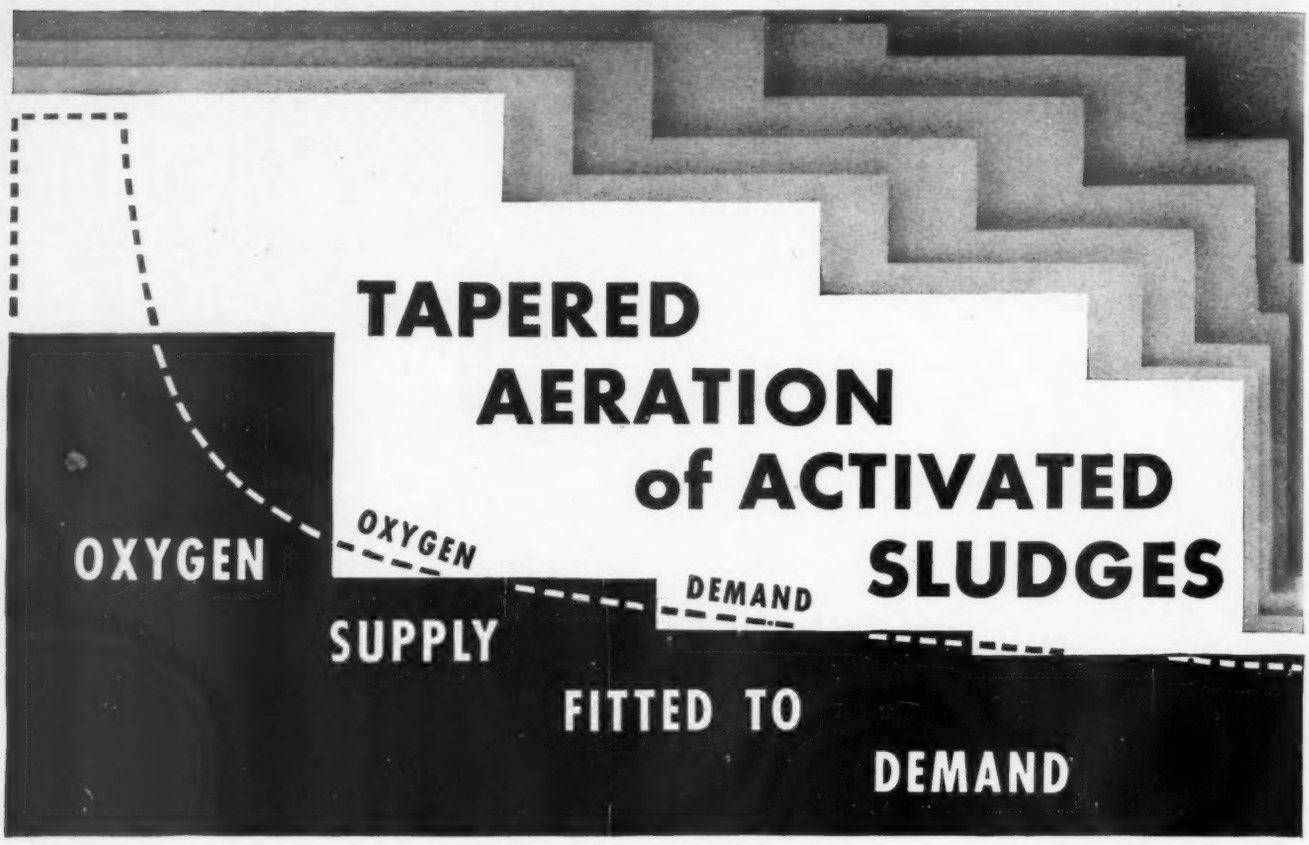
♦

1933
110 PAGES



& SEWERAGE

devoted exclusively to waterworks and sewerage

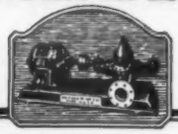


MECHANICAL AERATION and AIR DIFFUSION

Write for Complete Information on Tapered Aeration

SEWAGE EQUIPMENT DIVISION

CHICAGO PUMP COMPANY



VACUUM—CONDENSATION—CIRCULATING—BILGE
FIRE — HOUSE — SEWAGE — SCRU-PELLER PUMPS
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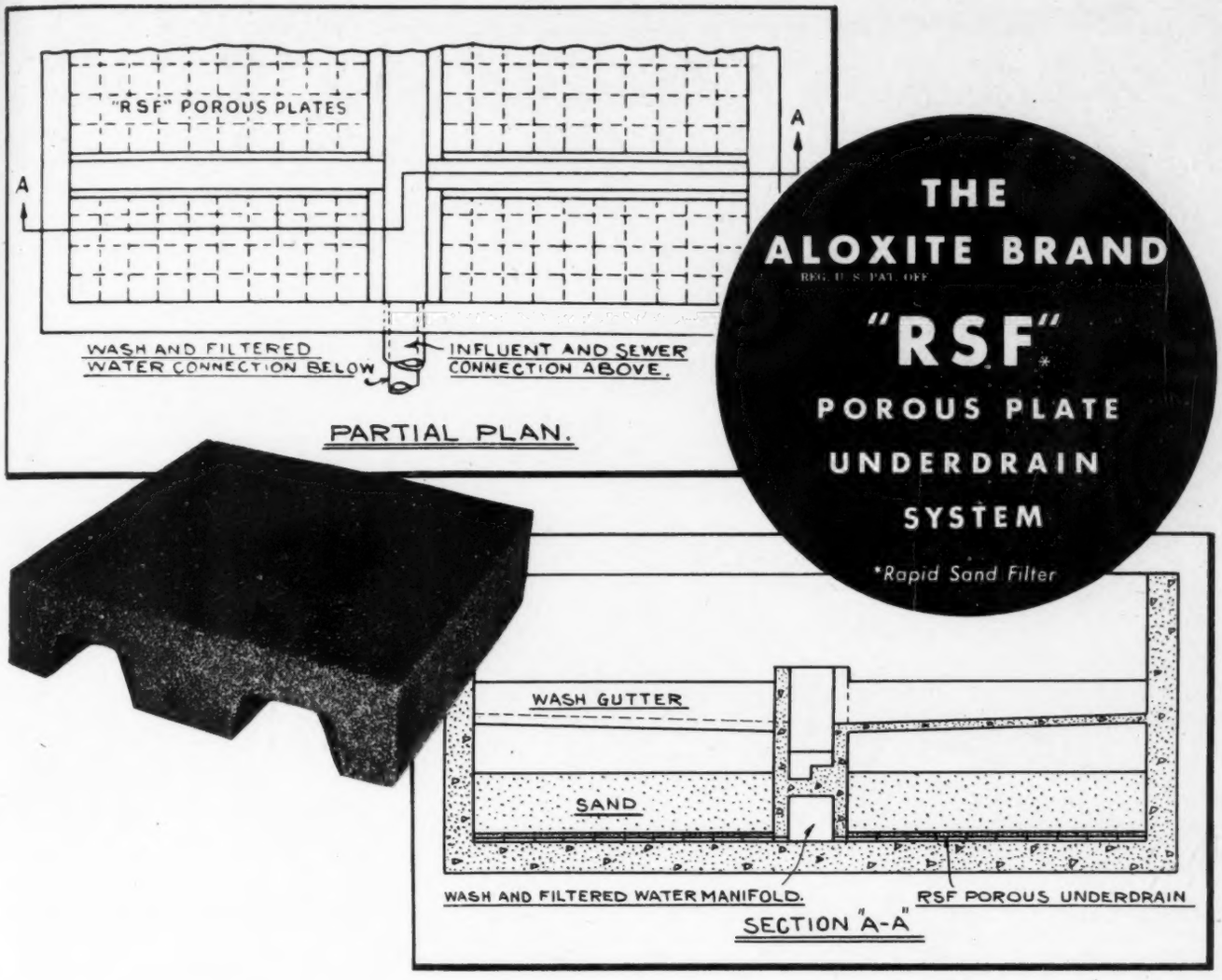

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Every installation has proved that here is the most outstanding improvement in filter design in years.

In addition to installations of the regular "RSF" plates, with distribution laterals formed on the under side, plain Aloxite Brand Plates of a similar grade and supported on ridges have been used in some filters.

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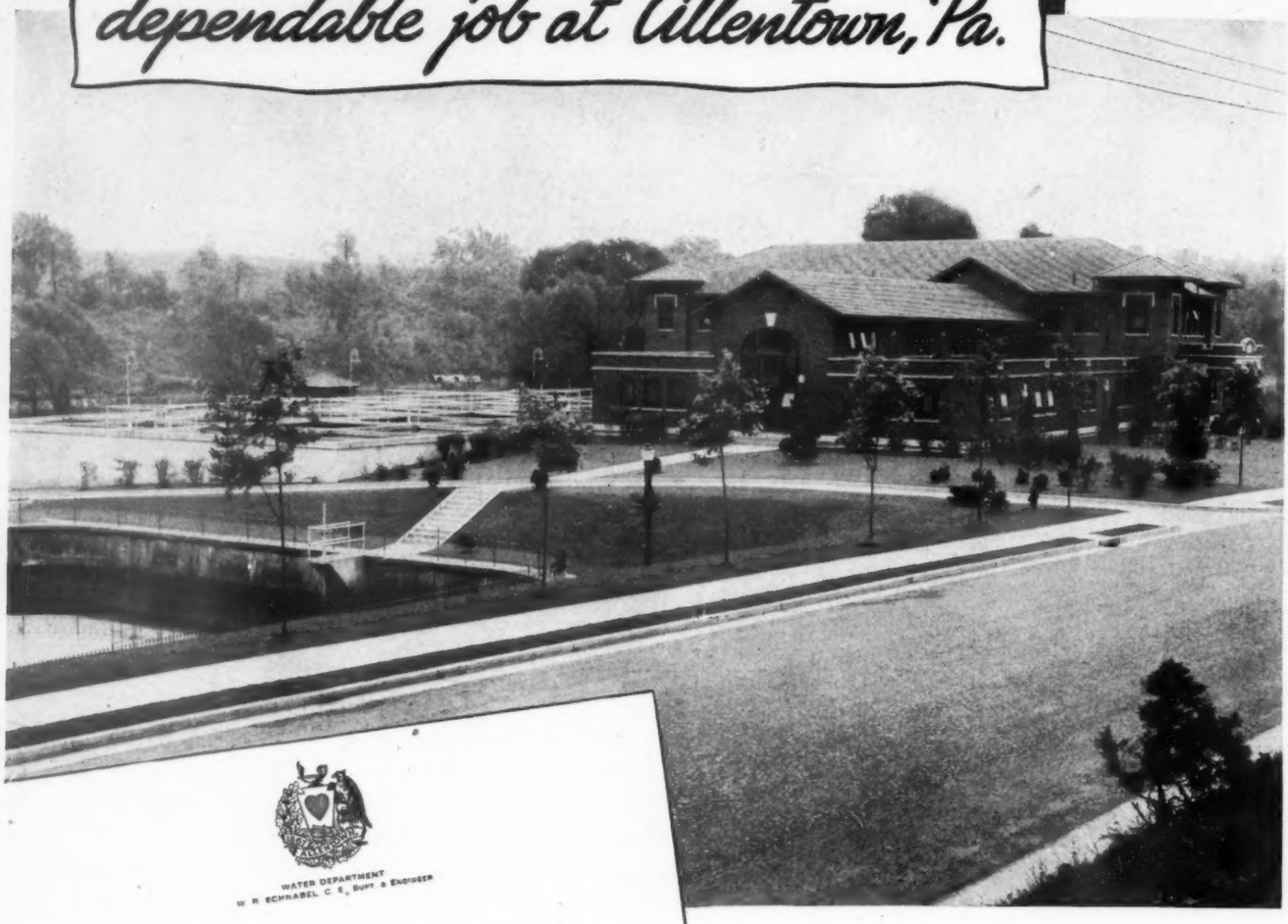
Mathieson Chemicals do a dependable job at Allentown, Pa.



WATER DEPARTMENT
W. R. SCHNABEL, C. E., SUPT. & ENGINEER

September 26,1936

The Mathieson Alkali Works,Inc.,
60 East 42nd St.,
New York, N. Y.

Gentlemen:

We are pleased to reply to your recent inquiry regarding our use of and satisfaction with your products.

It may interest you to know that we have been users of your liquid chlorine for over twenty years. In this time we have been well served and have not been subjected to any inconvenience from dirty or sticky cylinder valves which we consider a distinct advantage.

We have also been users of HTH since its first introduction several years ago. We have found this product particularly useful in sterilizing our water mains up to 12 inches diameter.

In addition we have used HTH in our public swimming pools for sanitary purposes in foot baths and for cleaning up around the pools and as an emergency source of chlorine in the pools.

In the large,36 inch mains,we have found it economical to sterilize by adding liquid chlrine directly to the water from a cylinder transported to the job in a rig of our own make-up.

We might add in closing that we are small users of your light soda ash and have found this product as uniformly satisfactory in quality and from a service viewpoint as our other purcshses from you.

Yours very truly,
Supt. & Engineer

WRS:B

FROM the City of Allentown, Pa., comes this further evidence that water works men appreciate quality chemicals and dependable service—and that they select their sources of supply accordingly. Certainly Mr. Schnabel, whose letter is reproduced at the left, has shown his appreciation of these things in a very tangible way by using Mathieson Chlorine for over twenty years. Moreover, when he has needed other chemicals made by Mathieson, he has looked for—and found—the same high quality and prompt service that he had long come to associate with the name Mathieson.

The* MATHIESON ALKALI WORKS *(Inc.)
60 East 42nd Street **New York, N. Y.**

Soda Ash . . . Liquid Chlorine . . . Bicarbonate of Soda . . . HTH and HTH-15 . . . Caustic Soda . . . Bleaching Powder . . . Ammonia, Anhydrous and Aqua . . . PH-Plus (Fused Alkali) . . . Solid Carbon Dioxide

WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher

L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"Developments of 1936 in Sewerage and Sewage Treatment" is the caption of an annual review—this year, by Professor Chas. Gilman Hyde, of the University of California, who needs no introduction as teacher, scholar and leading sanitation authority that he is. In addition to his reputation technically, as "Dean of Men" at California there has been none so well liked. With much pride we announce Professor Hyde as author of the February issue feature.

"How Much Water Do We Consume—How Much Do We Pay For?" is the ever interesting question which Chas. H. Capen, Jr., Engr., North Jersey Water Supply District, attempts to throw more light on. He discusses the matters of per capita consumption and the relationships between consumption, revenue and population. This constitutes the fifth in a series of articles by Mr. Capen which have been running in WATER WORKS AND SEWERAGE.

"The Effect of Activated Carbons on Sludge Digestion" by C. E. Keefer and Herman Kratz records the results of a study, conducted at the Baltimore Sewage Treatment Works, which thoroughly tested the merits of powdered activated carbon as an improver of sludge digestion and quality of gas produced.

W. C. Lawrence, Sup't. of Filtration and Mathew M. Braidech, former Senior Chemist, Cleveland Water Department, describe "The Cleveland Experimental Pilot Plant at Baldwin Filtration Plant" and set forth results coming out of extended experimental runs of this carefully operated and exactly controlled plant.

John R. Baylis, Chicago's Physical Chemist, and Associate Editor of WATER WORKS AND SEWERAGE, will continue with his new series of articles dealing with **"Coagulation."** The first, which appeared in our December issue, revealed the effects of compounds of silica on coagulation. Others of equal interest and importance are to follow in February and subsequent issues.

"Peelings to Power"—might be the title to denote the romance in the forthcoming article by Chas. A. Maguire, Providence's Commissioner of Works, and Philip Holton, Jr., Mechanical Engineer, which will tell of the successful Providence, R. I. project involving the operation of a specially designed modern garbage incinerator as a power plant. The power produced from wrapped garbage is already more than sufficient to run the city's activated-sludge sewage plant, next door, with a surplus available for operating the main sewage pumping station. In this accomplishment there is real romance.

Frank Murphy, Sup't. of Maintenance, Milwaukee Water Department, will describe meter-shop practices at Milwaukee, "Kinks" and novel schemes developed.

"Pipe Line Corrosion Control" is the subject of an article by Sheppard T. Powell, Baltimore Chemical Engineer, which relates a method of corrosion suppression involving mechanical de-aeration and chemical deoxygenation of water entering a long line. Results are presented which cover a period of sufficient duration to reveal definite technical effects and economic considerations.

Vol. 84, No. 1

CONTENTS for JANUARY, 1937

Progress in Water Supply and Treatment During 1936 1
By LEWIS V. CARPENTER
Professor of Sanitary Engineering, New York University, N. Y.

Gas Engine Installation, Aurora, Ill. Part I—The Plant Arrangement . 11
By WALTER A. SPERRY
Supt., Aurora Sanitary District, Aurora, Ill.

Ground Water Flows and Yields 16
By R. L. McNAMEE
Of Shoecraft, Drury & McNamee, Engineers, Ann Arbor, Mich.

Sludge Disposal by Incineration 18
By PHILIP B. STREANDER
Watson & Streander, Consulting Engineers, New York City

Compound Weather and Climatic Cycles 25
By H. P. GILLETTE

Meeting New York Section of A.W.W.A. 27
By HARRY A. FABER
Associate Editor

Limestone Contact Bids for Corrosion Control 29
By I. M. GLACE
Consulting and Supervising Engineer, Harrisburg, Pa.

Editorial 32

Equipment News 56

Catalogs and Literature Received 58

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Ask Chicago about Cast Iron Pipe

A satisfied customer will patronize his tailor or barber or drive the same make of car for years. But when a great city, with its changing administrations and engineering staffs, uses the same material for a vital public service throughout 86 years, it means more than good service. It means that cast iron pipe serves better than anything else that has been found. The City of Chicago has used nothing but cast iron pipe in its water distribution system since the first installation in 1851. Most of that original cast iron pipe is in service today. Chicago's experience is not exceptional. More than 95 per cent of the water distribution systems of our 15 largest cities consists of cast iron pipe. Cast iron is the standard material for water mains. Its useful life is *more than a century* because of its effective resistance to rust. It is the one ferrous metal pipe for water and gas mains, and for sewer construction, that will not disintegrate from rust. Available in diameters from 1¼ to 84 inches. For further information, address The Cast Iron Pipe Research Association, Thos. F. Wolfe, Research Engineer, 1013 Peoples Gas Building, Chicago, Illinois.

A section of Chicago's original cast iron water distribution system, about 95% of which is in service today.

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1. Her water distribution system is 100% cast iron pipe.
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3. More than 500 miles of cast iron mains, laid 50 years or longer, are in service.
4. Oldest cast iron pipe in service—86 years old.
5. 3745 miles of cast iron pipe in the water distribution system as of December 31st, 1935.

CAST IRON PIPE

The Standard Material for Underground Mains

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 84 JANUARY, 1937 No. 1

PROGRESS IN WATER SUPPLY AND TREATMENT DURING 1936

By LEWIS V. CARPENTER
Professor of Sanitary Engineering, New York University, New York

The Author

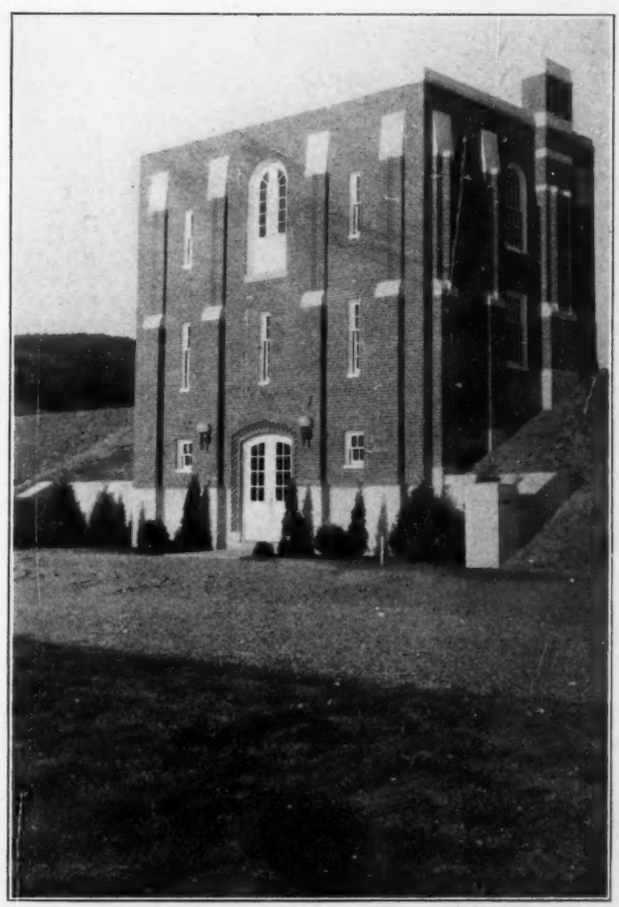
EACH year new water supply problems present themselves—and, they are solved. Probably no profession has the new problems presented to it as does the water-works profession, and the progress of the profession is the solving of these problems. This year developments have been largely confined to improving on the old solutions with the benefit of new tools and appliances with which to work. But the cycle of progress is onward, ever onward.

Water supplies have come in for an unusual share of publicity in the newspapers as well as in the technical press during the year. In certain parts of the country the most severe winter in the memory of living generations was encountered; then, on the heels of this, the floods in the East topped all existing records, and in the central West another year of deficient rainfall, dust storms, and shortage of water made headline news. In most instances, water works men came through with flying colors, again demonstrating the versatility of the profession in producing safe drinking water under adverse circumstances. One outstanding lesson learned was the great value of reserve storage of finished water.

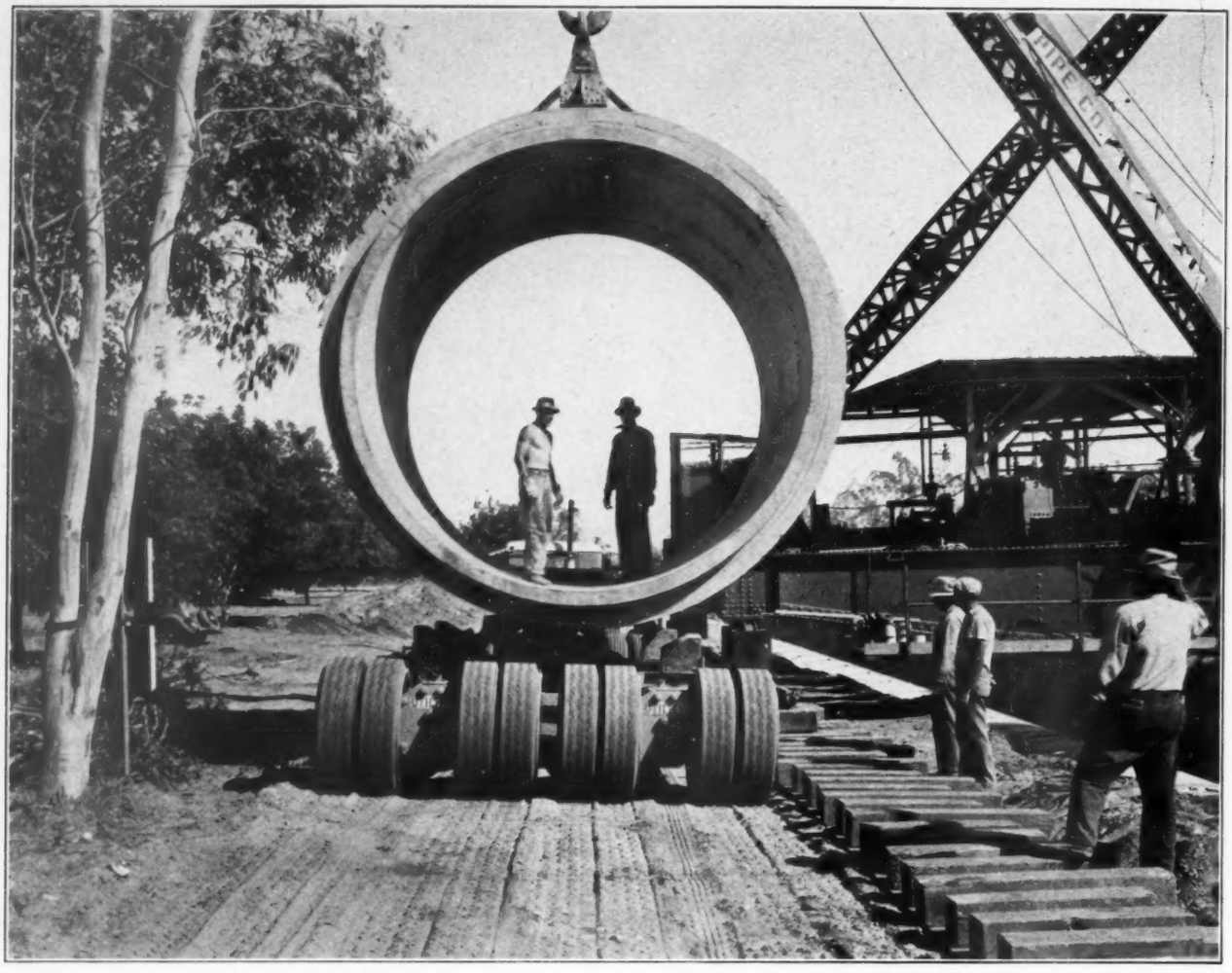
The cold weather of the past winter caused the Iowa Water Service Company to advise consumers to waste water by leaving the faucet open during the cold weather, and offered a very low rate for excess water used during the winter time. In Dubuque, Iowa, more water meters froze than ever before in the history of the Water Department. During the intense cold, towards the end of February, a water main in Utica, N. Y., broke and directly caused a series of explosions in gas mains located in the heart of the city. It was believed that a workman, in making the necessary repairs to the water main, made a spark with his pick, and that this ignited gas which had escaped in cable tunnels and sewers.

During the prolonged four weeks of cold, without letup, freezing temperatures covered the entire United States, except parts of Florida, extreme southwestern districts, and the Pacific Coast. In some northwestern districts, all records for continuous cold were broken.

Harry U. Fuller reported on certain studies being conducted in Portland in an attempt to make use of the Weather Bureau daily temperature records to predict with some degree of certainty the approach of danger to services and small mains with growing (cumulative) frost penetration. Observations of ground temperature, from thermometers located at various depths in test pits, are being correlated with air temperature records in the attempted evolution of a formula looking toward calculated predictions based on Weather Bureau records of mean daily temperature. The studies give promise of providing a means of utilizing air tempera-



Greenfield's (Mass.) New Filtration Plant. Representative of Works Which Rose Through Federal Aid as Relief Projects



The Largest Reinforced Concrete Pipe Ever Built. The Metropolitan Water District of Southern California (Colorado Aqueduct) Has Laid 10 Miles of This 152 In. Pipe. The Ditch and Pipe Line Is Beneath the Crane

ture readings for a previous period of days, in foretelling trouble and getting ready to cope with it. The Portland studies are worthy of hopeful watching.

The majority of frozen water services were thawed by means of electric current, although in Omaha, Neb., there was one plumber who used a device called a "steam needle." The "needle" consisted of a very small copper tube supplied with steam from a small portable steam boiler operating under 100 lb. pressure.

Floods and Drought

In March, one of the worst floods in history swept over New England and the Middle Atlantic States. Numerous water supplies were flooded and some large cities, such as Harrisburg, Pittsburgh, Binghamton, and other large cities, were without water for several days. Emergency supplies were used and water works engineers and managers handled the situation admirably. It is particularly apropos to mention the splendid work of the Wallace & Tiernan field organization, and headquarters "fiying squadrons," in rushing emergency chlorination facilities to cities no longer served by regular transportation facilities. The public health record during and after these floods was one to be proud of, and the water works profession has again demonstrated its versatility in coping with a difficult situation, wherein modern tools and materials were available and were put to their best usage.

The drought was reported to be the most severe in the climate history of the United States. The summer of 1936 was the driest on record in the Dakotas, Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana; second driest, in Ohio, Kentucky, Oklahoma, Kansas, and Montana. However, due to preceding wet years, water supply was reported as a little better than the drought year of 1934.

So, 1936 was a year of too much water, not enough water, too much cold, too much heat—all depending on where you were located and the time of the year.

New Construction

Last year (1935), most of the new municipal water works construction was financed through PWA under grants of 45 per cent of the cost. During 1936, the same letters were being used, but the new arrangement of them (WPA) permitted the government to pay 75 per cent of the total costs of improvements. Never before in the history of this county have municipalities and other political subdivisions been able to carry on so large programs of water supply betterments at such a small cost. The latest available figures indicate that over 2,500 projects were in operation in 1936 with the federal government contributing approximately $25,000,000. There are another 2,000 projects which have already received presidential approval. W.P.A. officials estimate that the total cost of these projects already approved will be $100,000,000 and that 32.7 per cent of that figure represents materials and equipment.

Atlantic City is building a 350,000,000 gallon reservoir, a 4,000,000 gallon water storage basin, and a

modern chlorination plant to treat all of the water to be consumed in the city. Probably the world's largest elevated storage project involving 3 tanks of 2 M.G. each is under way in Buffalo, N. Y. Every phase of water treatment and distribution has come in for their share of federal funds. As a few examples: Charlottesville, Va., is adding 750,000 g.d. capacity to its filtration plant; Denver, Colorado, a new pipe line and filtration plant; Front Royal, Va., is installing 800 water meters and meter boxes, and replacing 400 house service connections with copper tubing; Otis, Cal., sunk a well shaft 200 feet deep and installed pumping equipment; New York City has a leak survey and consumption study and a blanket city-wide pipe-laying project, etc.

All of this federal money is naturally placing the private water company in an unfavorable position. A number of private water plants have been bought by municipalities during the year. The American Water and Electric Company absorbed the water plants of the Community Water Service, and now operates more plants than any other single company.

Aqueducts and Supply Mains

New York City began work on the new Delaware supply which will take about 10 years to complete. The Los Angeles Aqueduct from the Colorado River is progressing satisfactorily. Also, ahead of schedule is the Metropolitan Water District of Southern California, which involves the "world's largest precast concrete pipe" (152 in. inside diam.), which weighs 43 tons per 12 foot length. The City of Baltimore is constructing a concrete tunnel 12 feet in diameter and 7 miles long. Denver is carrying water through the Moffat tunnel from the west side of the Rockies. San Jose, Cal., has recently abandoned the all wooden flume for a metal one. The wooden one was installed in 1870.

Distribution Piping

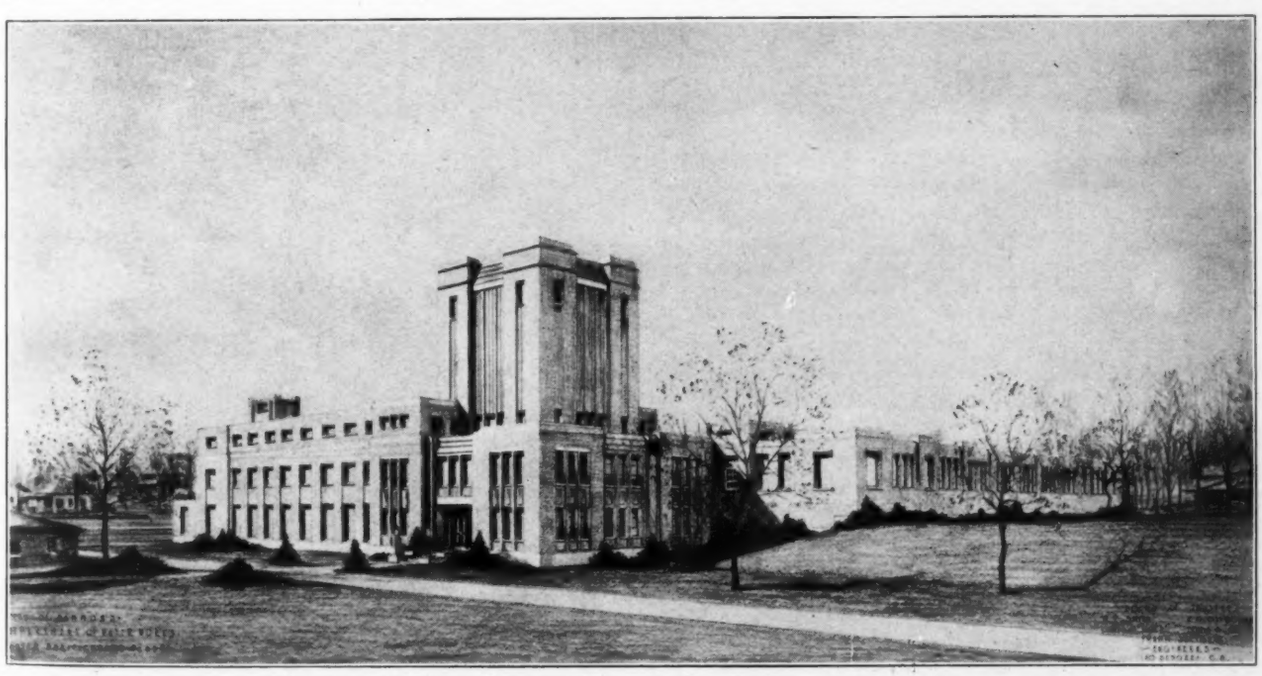
Centrifugally cast concrete pipes are now being built in sizes from 3 to 36 inches with a strength of 23,000 pounds per square inch and "Transite pipe is also now available in diameters up to 36 inch. Electric arc welding is being used on most of the large steel lines and the X-ray is being used to test the welds. Welds in the heavier pipe lines are being annealed. Bituminous linings have been improved, and this type of lining is being used extensively on pipe lines in the West, while the East is using more and more cement lined cast iron pipe. Copper continues its popularity as a service pipe material in small sizes. Cast iron pipe of 2-in. diameter is now available in 9-ft. lengths, with either threaded or pre-caulked ball and spigot joints.

Operation and Maintenance

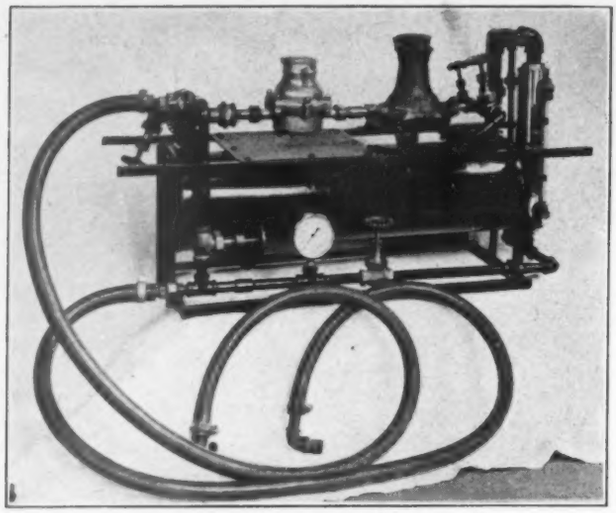
Meters, "the cash-register of the water department," are being improved and several plants have contributed new technique for meter testing that has proved very valuable. The "Meter Master," when connected to the meter of a complaining customer, produces a chart over a 24-hour period which becomes a convincing record that has so impressed the customer that he concedes the meter registration and the bill. In addition to creating "good-will," it proved valuable as a check on the accuracy of large meters and as a guide to the proper size of meter and service lines for various buildings.

Cook at Paterson, N. J., cooperated in developing an automatic meter testing machine which eliminates the personal element in everything except reading the registration dials. The machine operates by electricity and automatically shuts off when one cubic foot has run through the meter. Both new meters, purchased on a specification for accuracy, and old meters are tested by this machine. The author believes that through increased efficiency of meter testing during the past eight years, the fraction of total output of the plant collected for has been increased from 80 per cent to 90 per cent.

The Memphis Meter & Leak Tester, developed by Gen. Supt. McCord, consists essentially of a small tank that serves as an air compressor, a calibrated measuring chamber, flexible connections to connect to the street side and property side of the water line, a calibrated meter, and a calibrated orifice tank. The measurement of leakage must be done under the pressure that exists at the particular location. To make this leakage visible a bubble of air is inserted and becomes visible in the



One of America's Newest and Most Important Plants of the Year Serves Hammond, Ind.—Engineers, Leo Besozzi and Greeley and Hansen



The Memphis Portable Meter Tester and Leak Detector

sight glass. The Memphis Water Department has found this device very valuable in reducing leakages which have been found too small to register on the meters.

Equipment is now available for inserting valves into water lines under pressure. One case was reported during the year of the installation of a 24-in. valve in a cast iron main under pressure. At Danvers, Mass., compressed air is used to blow water from mains in case of break. This speeded up cut-in jobs and made better working conditions (dry ditch, etc.) for repairs. At Utica, N. Y., the use of chloramines to check tuberculation and growth of iron bacteria in pipe lines has been continued. Results reported a year ago were convincing to date, but results reported by Ackerman in 1936 offer proof of the value of chloramines in sustaining the capacity of the pipe lines at Utica and indicate the biological nature of the nodular depositions of previous years.

Cement mortar joints for cast iron pipe are being used extensively in the South and West. Main cleaning has been done on a larger scale during the year, but its real value has not been given the recognition merited, strictly from a dollars and cents point of view.

An Outstanding Main Betterment

Newark, N. J., completed the reconditioning of about 75 per cent of its main aqueduct system, involving a total of 50 miles of 32 to 46 year old riveted steel lines, ranging in size from 36 to 60 in. in diameter. In the first section of the project, the pipe was cleaned and coated with hot Bitumastic Enamel. The second section, completed in May, 1936, consisted of cleaning 27,500 lin. ft. of 40 year old, 38-in. diameter riveted steel pipe and relining with a protective coating of cement mortar to a thickness of ¼ in. A special type of collapsible pipe cleaning machine was used and a new centrifugal machine for mortar applications and smoothing traveled through the line. The success of this job can be best seen from the value of "C" in Hazen-Williams formula. Before cleaning the value was not over 110 and after cleaning and lining, "C" was 124 based on the nominal internal diameter of the pipe without lining. Compared with replacement, the per foot cost proved another favorable aspect.

San Francisco is rapidly completing the series of 75,000-gallon underground cisterns to be used for fire-fighting purposes should another earthquake fracture water mains. The cisterns are built of concrete, and do not have pipe connections. Manholes are provided for lowering suction hose from the fire department pumping engines.

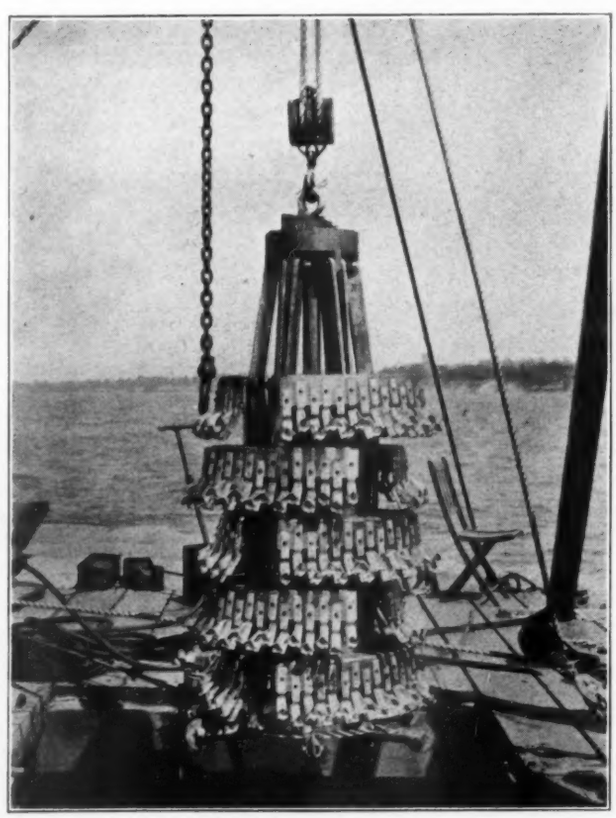
Plandome, L. I., water system is constructed with the storage consisting of 10 hydro-pneumatic tanks of 150,000 gallons total capacity located underground. The village would not consider an elevated tank and tower, because of the unsightliness of such a structure.

Work is well advanced on the construction of a separate industrial water system for the city of Birmingham, Ala. The rapid industrial growth of the city and the need for a low industrial water rate justified this improvement — financed through P.W.A. and W.P.A. Into the mineral water business plunged Excelsior Springs, Mo., which has bought out a mineral-springs water company, which is being operated as a separate division of the local water company for the benefit of the municipality operating the resort concession.

National Water Planning and Pollution Control

National planning, affecting water supply and treatment, has been carried forward chiefly under the auspices of the Water Resources Committee of the National Resources Committee. This cooperative Federal-State group has made an analysis of current data-collecting programs and has recommended specific programs to correct deficiencies in the measurement of precipitation, stream flow, evaporation, ground-water level, and quality of water. At present there is indication that the Federal and State legislatures may take action on these recommendations during early 1937 sessions.

The committee has initiated comprehensive investigations by State and Federal agencies of water resources in the Upper Rio Grande Basin and Red River of the



The Collapsible Pipe Cleaning Machine. Used in Preparing the 48 In. Main for Cement Lining to Recover Better Than the Original Capacity of the 40- Year Old Line

North Basin. The success of the latter study in formulating a program of construction and study relating to use of water for municipal water supply, recreation, wildlife, and the control of stream pollution and floods, has been in part responsible for the organization of a nation-wide study along the same lines. This "Drainage basin study" has brought Federal agencies (Corps of Engineers, Reclamation Bureau, Public Health Service, etc.), State agencies (planning boards, public health departments, etc.), and local groups into a common effort to state for each of the major drainage basins in the United States the following:

1. Major problems of water use and control.
2. A broad program of development of water resources, insofar as it may be determined at this time.
3. The specific construction and investigation projects which are consistent with that broad program of development.

The report, which treats water supply problems in relation to flood control, pollution abatement, navigation, power, erosion control, recreation and irrigation, should mark the first step in continuing process of revision of drainage basin programs by local, State, and national authorities.

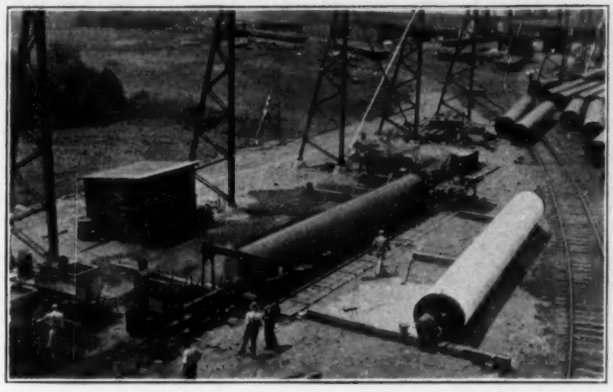
The committee also is sponsoring the standardization of hydrologic nomenclature, and the coordination of collection of water works statistics, drainage activities, flood damage data collection, and instructions for design and construction of small dams.

The year 1936 was distinguished by increased interest in national legislation for the control of water pollution. Extensive hearings were held on the Barkely, Lonergan, and other pollution-control bills, but no legislation was passed. It is probable, however, that the groundwork has been laid for passage of a bill creating a division of stream pollution control in the U. S. Public Health Service which would be authorized to make cooperative investigations, and to make grants and loans for pollution-abatement works.

Interest in pollution control has been reflected also in the organization of interstate conferences, having special concern with pollution, in the Ohio and Delaware basins. Joint investigations and interstate compacts now legalized in special acts have been under discussion in both areas and the organization meeting of Ohio Valley authorities has recently been held in Cincinnati.

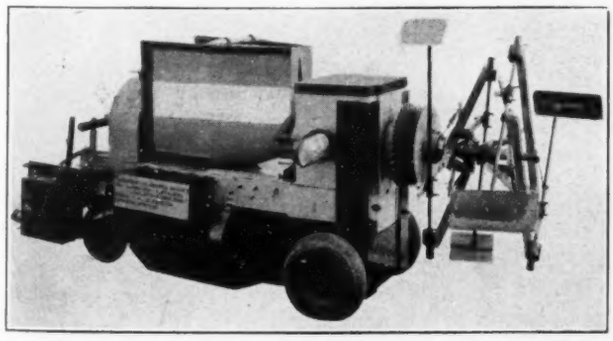
Growing Consumption and Air Conditioning

Water consumption during the year has continued to rise over the previous year. Part of this increase is due to air conditioning, but developments of cooling towers and evaporators for reclaiming the cooling water leads us to believe that the increased demand on the water system will not be as great as was thought a year ago. It has been estimated that the maximum demand for air conditioning will not be reached for 10 years and if evaporators and cooling towers are used, the increase in water consumption will amount to from 23 to 35 gallons per capita during the summer months. The average for the year should not exceed 3-5 gallons per capita per day. Unfortunately, the peak demand for air conditioning water occurs at the same time as for other purposes. Last summer the daily demand during the very hot weather became as high as 500 per cent of the average. It seems as though some distribution systems which are now operating near capacity may have to be revamped as the result of the growth of air conditioning. The writer has so far seen no real reason to become alarmed over this increased use of water. American engineers, generally, devise ways and means of eliminating costs; and, it seems as only yester-year when water works operators became alarmed at the possible loss of revenue from the tiny jet of water used in gas refrigerators. Today modern gas refrigerators do not use water. The quantity of water used in air conditioning should drop as mechanical improvements are made.



Pipe Lining and Coating with Coal Tar Enamel and Whitewashing Operations. Birmingham's Industrial Water Supply Gets Well Under Way

And, then, there is the water supply of Riverside, Calif., which itself has to be "air conditioned." Water from a 20-in. flowing well, 1,000 ft. deep, emerges under a pressure of 10 lbs. per square inch at 110 deg. F. Through an evaporative system it is cooled to 80 deg. F. in order to render it suitable for domestic use.



Ingenious Centrifugal Pipe Lining Machine Used on the Newark Project. Note the Mortar Distributing (Multi-Toothed) Centrifugal-Head Behind the Smoothing Trowels

Epidemics

On February 18 and 19 there was reported from Coshocton, Ohio, the prevalence of intestinal illness which reached epidemic proportions affecting 60 school children and 900 adults throughout the city (population 10,000). Early reports indicated the water supply as the cause, but we understand that no evidence could be found to show failure of purification. During March, 1936, Milwaukee reported 120,000 cases of a gastro-intestinal disease. Dr. Koehler, health officer, reported the cause of the outbreak as "unknown," and is to be commended for refusing to blame it on the water supply in spite of the circumstantial evidence directed toward it. Several small epidemics have occurred during the year. Bacteriological tests according to Standard Methods of Analysis, indicated the absence of the Coli-aerogenes group. Indications are that it will be necessary to expand the regular bacteriological tests to include other than those organ-

A Unit in America's Most Important Elevated Storage Project, Buffalo, N. Y. The Second of Three Tanks of 2,000,000 Gals. Capacity Each, Located at Widely Separated Points, Has Been Completed

isms which ferment lactose. The largest water borne typhoid epidemic reported was one of some forty cases in New Jersey which was caused by drinking water from a polluted spring.

Plumbing Cross Connections

Water works men continue to use every safeguard to protect the public. Ever since the A.W.W.A. required that the plumbing of convention hotels be approved before holding a convention, water works men have been discussing plumbing cross-connections. The consensus of opinion is that the water department should have something to say about plumbing layouts beyond the meter. The Hackensack Water Co. has a regular plumbing cross-connection engineer who works full time on this problem. The New Bedford, Mass., Water Department employs a full-time Engineer and Inspector of Plumbing; boasts an ordinance which requires Water Department O.K. on all new plumbing and piping on owners' premises connected to city water supply—a development of 1936.

Growth in Automatic Operations

Automatic control equipment has been installed in a large number of pumping stations. Float switches, pressure hydrostatic control, and electric time switches are being used to make plants self-operating, incidentally helping increase unemployment. Residual chlorinators have been developed so that it is economy to install them as they feed only the actual amount of chlorine needed. Los Angeles reports large savings of chlorine by the use of these residual chlorinators. A unique plant at East Lansing, Mich., softens and removes iron automatically in pressure zeolite softeners. Pumping of water through the plant is at a constant rate, thus making it possible to control the softening cycle on a timed basis. An electrical sequence time-switch is provided for this purpose, initiating the automatic regenerations of the pressure zeolite softeners at timed intervals and in definite sequence. This switch is a synchronous motor-driven device with five normally open load circuits (one for each softening tank) and one resetting circuit.

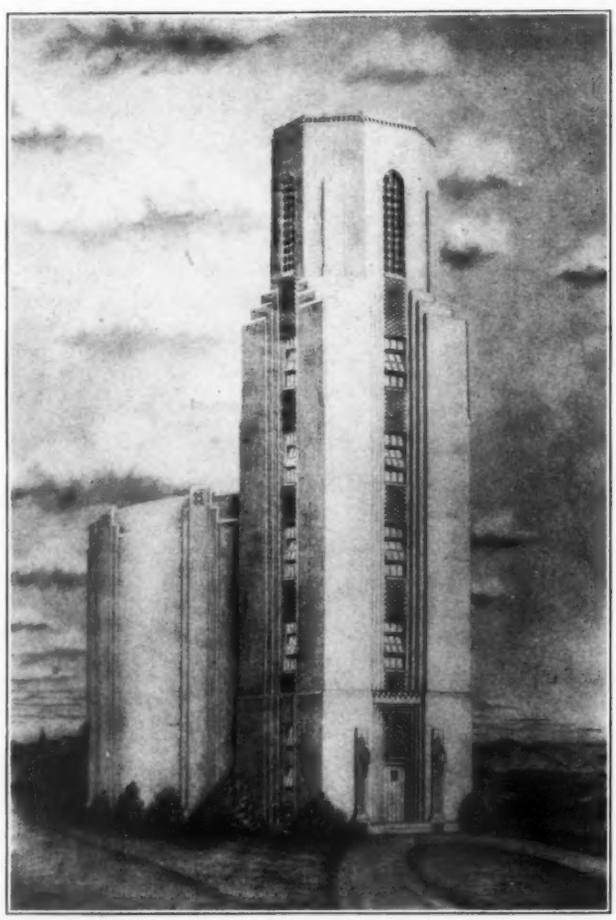
Each softener is equipped with a motor operated multiport valve which controls the regeneration of the unit after the sequence switch has started the regeneration of a unit; the steps in the regeneration process are controlled by a timing motor and float controlled switches.

Three units contain sodium zeolite for softening and the other two manganese zeolite for iron removal. The free CO_2 is reduced by adding caustic soda more economically than by aeration entailing double pumping.

Novel Filtration Plants

The second unit of the circular filter plant (steel tank construction) was completed at Burnt Springs, Md., by the Washington Suburban Sanitary District. The plant has been named "The Robert S. Morse Filter Plant," after the inventor of this novel filtration system. Mr. Morse, Chief Engineer of the Sanitary District, died during the year. He lived, however, to see his first plant a proven success.

Possibly the most novel filter plant of the year was built at Lexington, Va. Due to peculiar operating conditions it was found economical to design an 800,000 g.p.d. capacity plant in vertical rather than horizontal layout. The unique features of this plant consist of a vertical cylindrical reinforced concrete sedimentation tank 39 ft. in diameter and 40 ft. high with filter tanks and mixing chambers built into the top of this coagulation tank and at such elevation as to obtain



Filter Plant of Novel Design Goes Into Service at Lexington, Va. (Wiley & Wilson, Engrs.)

gravity discharge of the filter effluent into the present distribution reservoir which occupies the top of the same hill. The filters are located on the "fourth floor," approximately 100 ft. high. This plant, which is well designed and architecturally pleasing, towers above Lexington as a sort of shrine to the ingenuity of water works engineers who have a flare for the original.

A new filtration plant, using water from the West side of the Rockies, under construction at Denver, has the following design features: Pre-treatment through the use of modern flocculation methods and settling facilities enables the filters to run at much higher than normal rates; wash water detention is provided since gradual discharge into an irrigation ditch is planned in the summer while the water will be reused during the winter when the sludge will be allowed to accumulate in the settling basins; and, over the operating gallery is a clear vaulted ceiling with supporting beams

Robert B. Morse Filter Plant at Burnt Mills, Md., Has Two New Units Added

above the roof. A quick mixing period of between 4 and 5 min. of violent agitation, created by the velocity of the water itself, is followed by a combined flocculating and sedimentation basin, with 40 min. of flocculation followed by 3 hours of quiescent settling. Each of the ten filters has a rated capacity of 5.6 m.g.d. when operating at a rate of 2.8 gal. per square foot per minute. The filters have 24 in. of gravel and 22 in. of sand.

Trends in Filtration Design

The present trend in filtration seems to be towards coarser sand and a more shallow depth of it. Few plants now use as much as 24 in. and the prevailing specification lists the effective size as 0.45 to 0.60 mm.

The time honored rate of filtration (2 gallons per square foot per minute) seems slated to go. Most water works engineers now favor higher rates with more emphasis on effective preparation of the applied water. The plant at Oakland, Calif., was rated at 3 gallon per square foot per minute. Perhaps the outstanding feature of the filters there is an arrangement of redwood "box-baffles" that extend from the floor of the filter to the bottom of the sand bed. These baffles run in both directions forming what might be called "egg crates" into which is placed the various layers of gravel and coarse sand. The purpose of these "egg crates" is to prevent lateral flow of wash water through the coarse gravel that usually results in disruption of the gravel beds.

The porous plate type of filter bottom is gaining favor. Mamaroneck, N. Y., is at present equipping one of its filter units with this type of carborundum bottom, with the expectancy of completing the work after a proving-up period. Surface filtration has been used successfully at Kenilworth, Ill., and at Toledo, Ohio, where a larger quantity of water was desired than the existing filters would supply. Surface-wash (Baylis System) has been installed at Racine, Kenosha, and Milwaukee, Wis., and at Covington, Ky. Surface wash has been used at Charleston, W. Va., for a number of years. The principal difficulty with surface washing is the lack of evidence to indicate the most effective ratio of wash-water applied through the underdrains to that through the upper distribution system.

At least two plants installed air wash systems in existing filters. A notable advance has been made in recent years in the simplification of the pipe work and appurtenant equpiment found in the pipe gallery of the modern plant. The ill-lighted, inacessible and often dripping condition of the pipe gallery itself is becoming a thing of the past. The only improvement over a well-arranged pipe gallery is perhaps no pipe gallery at all, such as is virtually the case at Burnt Mills, Md. (Morse Plant), and at Ford Dodge, Ia.

In the latter, the pitwork is reduced to a minimum, the rate controllers being installed in individual inspection wells, and the pipe gallery space converted into added filtered water storage capacity. One arrangement of filter piping that offers numerous advantages involves the placing of the influent and wash water drain channels or conduits on the outside of the pipe gallery—i.e., on the opposite end of the filter box. By so doing, it is possible to substitute relatively inexpensive sluice gates on the influent and drain inlets and outlets of the filter units, in place of the more costly valves customarily employed.

Thirty-five municipal filter plants and 38 swimming pools and industrial filters are now using "anthrafilt" and in one or more units. In a few years, there should be some excellent comparative data between anthrafilt and sand, as many of the plants have only replaced part of their units with anthrafilt. At Denver, where 14 in. of sand with 6 in. of anthrafilt on top is in use, it is observed the coal does not have the same tendency to choke or coat as does the sand and the largest factor is reduced water consumption. One plant using coal on sand has had difficulty with mud balls at the sand surface line. During washing, the mud balls drop down to the sand level and the wash water does not break them up. Air wash has been found advantageous with low expansions, using anthrafilt.

Coagulation and Sterilization

Improved raw water preparation, involving chlorinated iron sulphate, at Richmond, has produced a "cleaner" finished product along with an approximate 67 per cent reduction in the quantity of coagulant required. Part of the settled floc mixed with new floc in the course of formation ("flocculation") increased further the effectiveness and economies of coagulation. More and more attention is being paid to raw water preparation to make permissible higher filter rates.

The use of iron salts has made further advances during the year. Chlorinated copperas has been found more effective in treating waters with descending turbidities and the mechanics of the treatment is becoming better known. Providence, R. I., now employs prepared ferric-chloride delivered to the raw water under pressure by Proportioneer's Ferro-Feeders. Starting with chlorinated copperas, then going to Ferrisul, this plant has run the gamut by going now to ferric chloride produced in Providence. The difficulties of handling and shipping ferric chloride are being overcome and its use is on the increase. Activated alum ("Black Alum") after another year's work, has won a place among the leading coagulating chemicals. A new plant is now under construction to produce this novel carbonized alum.

The present trend is to add chlorine first and *thereafter* ammonia in ratio required to convert *only* the *residual* chlorine to chloramines. Of course, this procedure would not work when phenolic compounds were present, but permits a large saving in chemicals otherwise. Especially interesting is this scheme for ground waters. In London, they are using a combination of copper sulphate and chloramines for sterilization and algae control.

Coppering

New methods of distributing copper sulphate have been devised. At Wanaque, an ingenious device has been built for adding copper sulphate to the many streams entering the reservoir. Large crystals are placed in a dissolving box and a fixed proportion of the water entering the reservoir over a control weir is passed through the copper sulphate. (See drawing.) Los Angeles has developed a method of broadcasting (blowing) the dry crystals over the surface of the water, utilizing a specially designed power-driven scattering disc. San Francisco has developed a method of wet spraying the suspended chemical. The boat is equipped with a small centrifugal from which water passes, an injector to create a suction at the constricted section. At this point, a side opening admits the finely ground sulphate crystals from a feed-hopper. These are carried with the water, through nozzles, over the surface of the reservoir. An area 50 ft. wide may be effectively covered by this method.

At Council Bluffs, Iowa, at least two species of algae that did not respond readily to chloramine treatment have been found. Fine crystal copper sulphate, applied along the reservoir wall-face at the water surface proved very effective in removing algae which grew on the slab-slopes and wall faces.

Iron Manganese

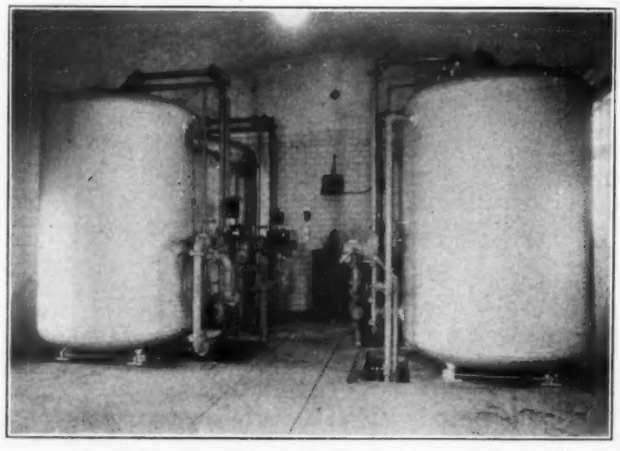
Investigations in Great Britain have shown that base-exchange material can remove all traces of lead, copper, zinc, and tin from water. They have developed certain synthetic resins which possess marked based exchange properties. At Chicago, some experimental work on softening waters of low pH in zeolite softeners indicated that the reduction in exchange capacity is not due to any disintegrating effect on the zeolite, but simply to new equilibrium conditions brought about by increased concentration of the H. ion in the water. This new equilibrium at a lower level of base-exchange capacity is established quickly, but the active life of the zeolite is no shorter as a result.

The manganese zeolite, for the removal of iron and manganese has developed so that the process is understood. During the year, several papers appeared on the removal of iron and manganese from water by the aid of a catalyst. "Birm" will remove iron and manganese only when the water contains sufficient oxygen to oxidize the metals. These processes are not new. Operators of filter plants, where manganese is present in the water, are all familiar with this catalytic removal and the subsequent enlargement of sand grains.

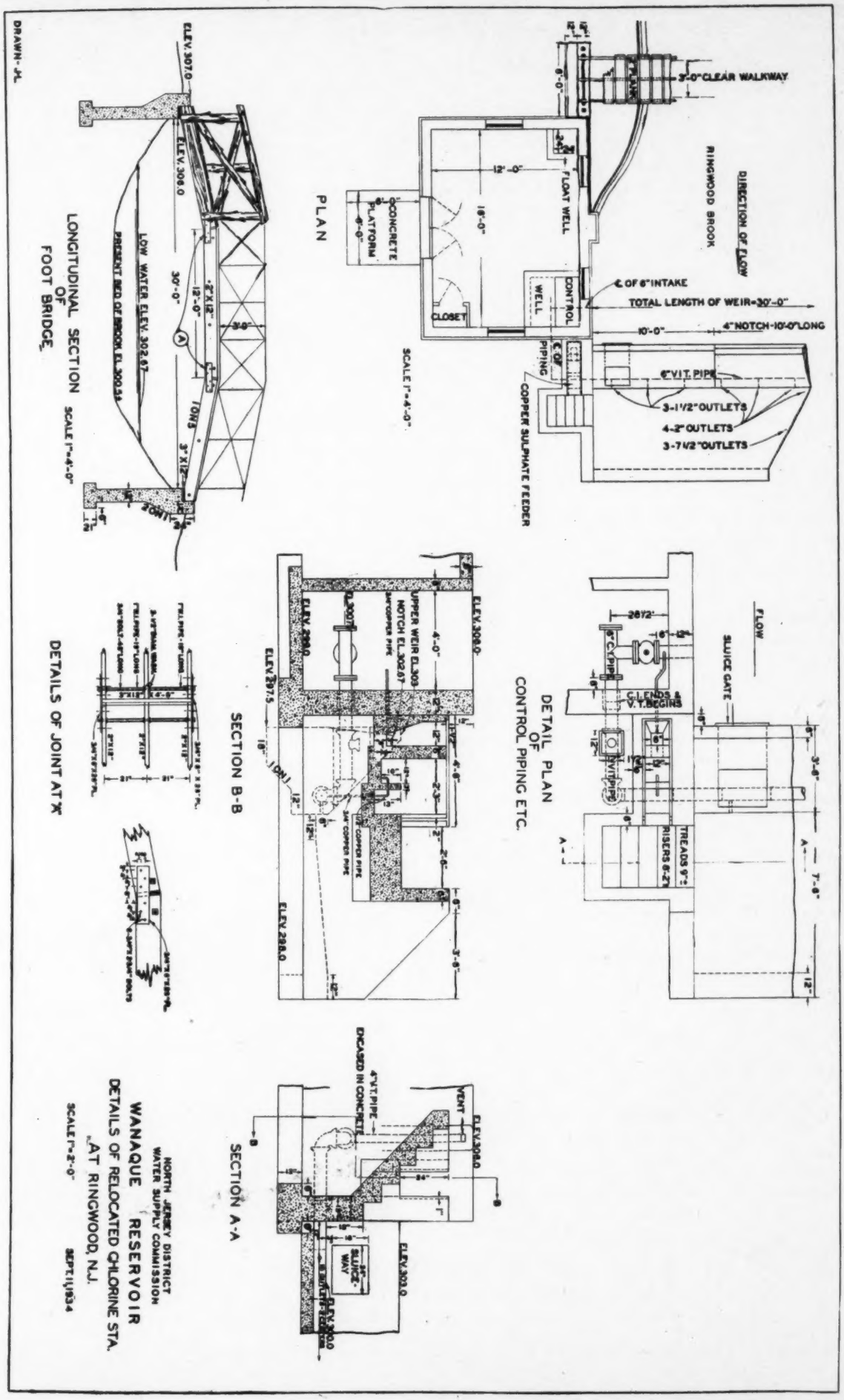
Hale reported on the removal of 3 to 5 p.p.m. of iron from a deep well water in New York City. The plant was unique in that iron is removed without areation. The plant has 10 horizontal pressure filters 20 ft. by 8 ft. Milk of lime was fed into the well water and could be run into reaction pipes which had a 10-minute detention period, after which it was filtered through the pressure filters. It was found feasible to add sufficient lime hydrate to neutralize the free carbonic acid to form calcium bicarbonate and produce a pH slightly higher than 8.0. The plant has been operating succesfully for two years without the addition of air. The free CO_2 overaged 35.7 p.p.m (1935) in the raw water and 0 in the filtered.

Corrosion Control

New knowledge has been added on corrosion control by the work of McLaughlin, Langelier, and Hoover. McLaughlin presented a new technique for determining the point of calcium carbonate saturation by adding lime to water in varying amounts to change the pH



Automatic Zeolite Softening Plant, East Lansing, Mich. The Battery of Units on Right Removes Manganese and Iron, Those on Left Are the Softening Units.



One of the Copper Sulphate and Chlorinating Chambers for Treating Streams Tributary to Reservoir at Wanaque, N. J. (Courtesy North Jersey Water Supply District)

by 0.5 increments. After determining the alkalinity and pH, calcium carbonate is added and the pH and alkalinity then determined on the filtered sample. By plotting change in alkalinity after contact with calcium carbonate, for a given pH, the pH of the treated water that gives no change in alkalinity is the proper pH to prevent corrosion.

Langelier derived from experimenal results an equation for the pH at which a given water is in equilibrium with calcium carbonate. He called this new value the "saturation index," which furnishes a new method which can be used in plant control in anti-corrosion treatment. Hoover, in some eminently practical tests, passed hot water, approximately 155° F., through galvanized tanks for a period of one year. Columbus' softened and pH adjusted tap water, with an average total alkalinity of 32 p.p.m., a phenolphthalein alkalinity of 13 p.p.m. and a pH of 9.3 was passed through one tank and it was badly pitted. Through a second tank city tap water was passed with enough CO_2 added to convert all the normal carbonates to bicarbonates. It had a total alkalinity of 42 p.p.m., a phenolphthalein alkalinity of 0, free CO_2 7 p.p.m and a pH of 7.5, and there was little or no pitting. The experiments seem to indicate that most of our theory of corrosion might have to be revised, particularly with respect to low alkalinity of waters containing all or nearly all calcium and magnesium normal carbonates.

Two 12-in. steel pipe of the Freeport Sulphur Company, using Mississippi River Water (pH 7.2-7.4), suffered a loss of capacity of 50 per cent due to tuberculation. After cleaning the pipe line, the water was deaerated under a vacuum of 27.5 in., which reduced the dissolved oxygen 95 per cent. The oxygen was further reduced by the addition of 0.14 lb. of sodium sulphite per p.p.m. of oxygen. The pipe line after a year has retained its original carrying capacity. [An article, disclosing operating results for this de-oxygenation scheme, by S. T. Powell, will soon appear in this magazine.]

Powdered activated carbon has been accepted as a standard chemical necessary to have around water plants and experience has shown that it will improve the quality of most water supplies, even when distinct tastes and odors are not readily detected.

The largest adaptation of beds of granular carbon is represented by the recent installation at Oshkosh, Wis., to be used in conjunction with powdered carbon for the elimination of a serious condition of taste and odors that could not be dependably removed by the powdered carbon alone. The impressive feature to council members and laymen is the low cost per capita per year which can be charged against the security of the granular carbon units—less than the price of one 5-gal. carboy of spring water per year per person.

Some A.W.W.A. Activities

The A.W.W.A. Sub-Committee on Testing Carbons issued a monograph on carbons which is really a "Standard Methods" for testing carbons. The A.W.W.A. Committee on Chemical Hazards presented a report on "Ammonia" which is just as thorough as its excellent report on "Chlorine" presented in 1935. The new Eighth Edition of Standard Methods of Water Analysis was published in August. It is the largest edition published with additional material on boiler water analysis and several new non-standard methods for determining some of the rarer elements found in water supplies. Determination of chlorine has been clarified in light of recent developments of interference with the orthotolidine reaction.

Numerous other committees of the Association are working on problems of interest to the profession. A new manual on *"Quality and Treatment of Water"* will be published early in 1937. Various State sections of the association are sponsoring activities which are helping to build up the effectiveness of the association. The appointment of Harry Jordan as Executive Secretary has stimulated the membership to greater activity, and big things seem to be ahead for A.W.W.A.

Licensing of Water Works Employees continues to be of interest and many states have prepared bills for submission to legislatures early in 1937. More short schools have been held than ever before in the history of water works. The outstanding developments of the year were the regional short courses. Outstanding regional school developments have been in Illinois, Virginia, Indiana, New York.

As each year comes to a close, it is always well to take inventory and see what we have to add to the credit side of the ledger. Then, it is well to sit down and look into the future and see what can be done to improve our product and ourselves. The record of the past year is one of which the operator can be justly proud. The heroic service rendered during drought, flood, and severe freezes, and the absence of water-borne epidemics are commendatory. Standards of operation have been raised, more men have affiliated themselves with National associations for the betterment of themselves and their profession, water works schools are crowded with men eager to improve their minds and many perplexing problems have been solved.

The outstanding need for the coming year is a pattern for improving the economic status of water works employees and a scheme for insuring some sense of security and tenure of employment to competent municipal water works employees. Legislation should be passed to do this, but that can only be secured after the water works men appreciate its value and demand it.

▼

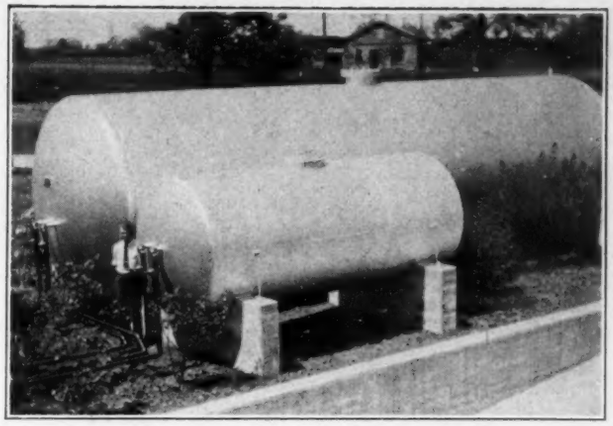
"Ick and Mick"

Both from Minneapolis.

To our attention has been called a case of mis-labelling in connection with the report of the convention of the Central States Sewage Works Association (Dec., 1936). The picture of Mr. Mick, chemist, Twin Cities Sewer-

F. L. Mick *Geo. J. Schroepfer*

age Commission, was captioned Geo. J. Schroepfer, Asst. Chief Engr., Twin Cities Sewerage Commission. Well, here they are side by each for the sake of correcting the records. One must admit that this sort of twin likenesses from the Twin Cities is enough to excuse ye Ed! Even their neckties are almost "twins."



Pressure Type Gas Holders—Aurora. Surge tank in Front Is 6 Ft. Diameter and 15 Ft. Long. (Floats on Line Between Digesters and Compressor.) Storage Tank in Rear is 10 Ft. Diameter and 40 Ft. Long. Holds 11,000 Cu. Ft. at 40 Lb. Operating Pressure.

GAS ENGINE INSTALLATION—AURORA, ILL.*

Part I—The Plant Arrangement

By WALTER A. SPERRY

Supt. Aurora Sanitary District, Aurora, Illinois.

The Author

THE Aurora Sanitary District is glad to present and record its chapter of experience in the present day modernizing movement of installing gas engines at sewage treatment works to reduce power costs. Some features of our installation are unique and may, therefore, be interesting to others, and possibly helpful.

The Aurora situation seemed peculiarly favorable for engine installation because of the following:

(1)—Gas production for five years has consistently averaged 11.6 million cubic feet, with a daily average of 32,000 cubic feet. The anticipated requirements for engine operation was 23,000 cubic feet, which left ample gas for incinerator operation and digester and building heat, when engine heat recovery was considered.

(2)—Due to extension of the intercepting sewer system, growth of the city, and the simultaneous installation of secondary settling basins, additional gas volumes were reasonably to be anticipated.

(3)—By reason of the plant being located five miles down river, we have no continuous raw sewage pumping load. Primary treatment is by gravity. High lift pumping to sprinkling filter dosing-chambers (against a head of about 26 feet) follows primary treatment. Due to dilution ratios of not less than one volume of sewage to 25 volumes of river water during the fall and winter months, advantage was taken to reduce operating costs by cutting back to primary treatment for 21 months the past five years. This policy saved the District $9,000, or $430 per month, for current. It left but $150 per month to cover scattered auxiliary motor loads.

(4)—Since our pumps operated at 690 r.p.m. gas engines could be directly connected, saving generator losses.

(5)—The annual possibility of cutting back to primary treatment during winter tended to balance the power demand for gas in the summer against heat demand in the winter.

(6)—The Aurora plan, thus far successful, of controlling odor nuisance by dilution of the raw sewage with river water, had increased summer pumping costs $50 per month. The gas engines absorbed these added costs, making dilution feasible economically as well as technically.

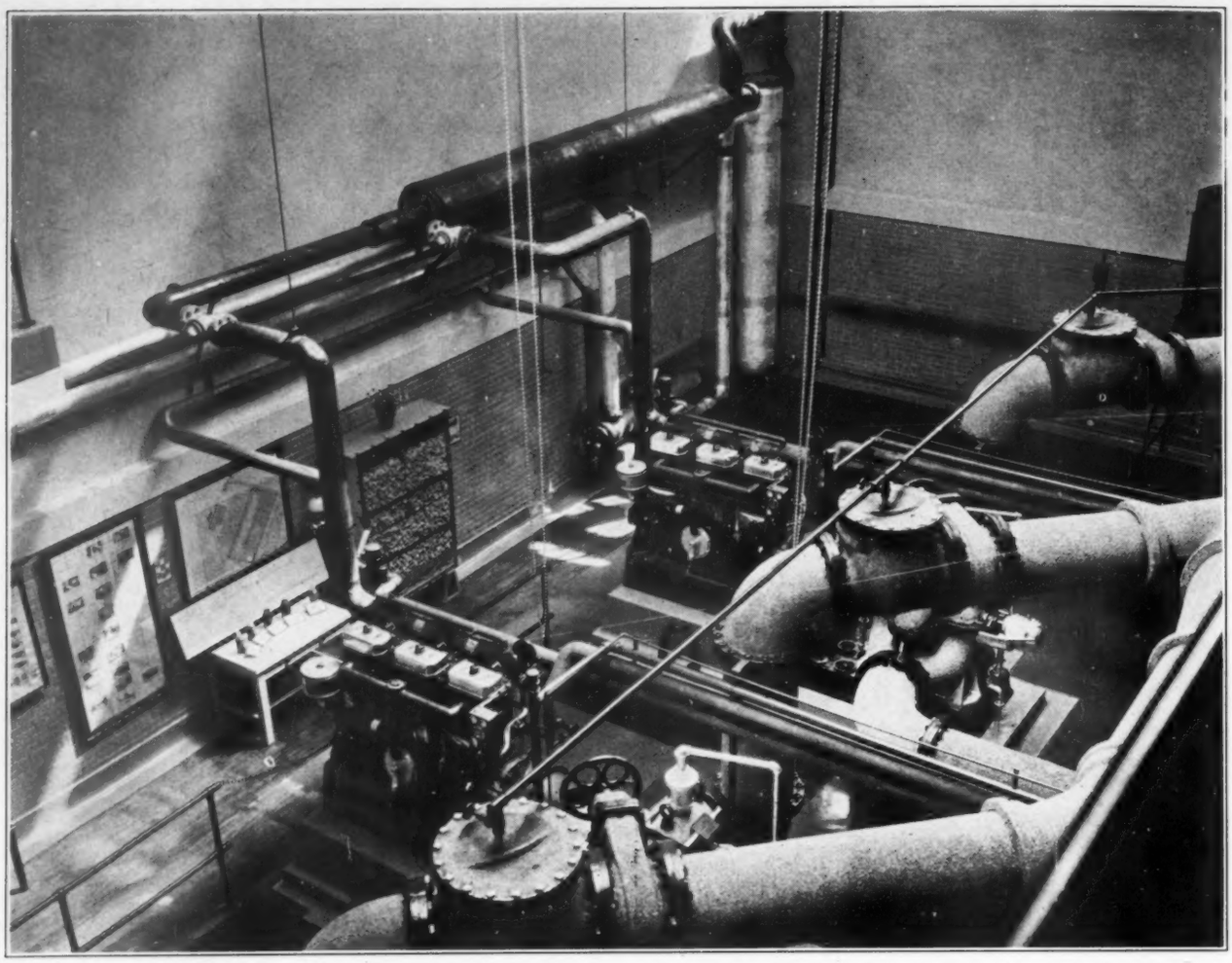
Alternate Plans

Two plans were studied. The first was two engines, direct connected to the pumps to handle the high lift flow with a third engine-generator set to handle the auxiliary motor load. The generator was to be of sufficient capacity to also operate a 50 H.P. motor-driven 6 M.G.D. high-lift pump, as desired. The engine-generator set was to have been planned with a right and left-hand engine, connected to both ends of the generator and double fueled with both gas and gasoline, giving complete breakdown and change-over facilities. This would make us independent of the local utility company.

We followed, however, the more conservative plan of installing two engines, direct connected to the pumps —one to run at any one time—giving complete change-over facilities, reserving for the future complete gas powering. Experinece, to date, indicates that this third engine-generator set can soon follow.

The entire scheme, including specifications and plans, was worked out by the District's personnel. The major credit for the excellent "fitting in" and successful operation falls to the District Engineer, Walter E. Deuchler, who wrote the specifications and prepared the plans.

*This paper, prepared for Water Works and Sewerage, was presented by the author before the Central States Sewage Works Assn. in Indianapolis, Ind., Oct. 30, 1936. In an early 1937 issue Mr. Sperry contributes Part II, which will disclose operating experiences, cost data, etc.—Ed.



General View of Aurora's Twin Gas-Engine Installation 70 H.P. Climax "Blue Streak" Direct Connected to 8 M.G. Pumps, Automatically Operated at 500 to 800 r.p.m. to Pump at 3 to 12 m.g.d. Rates, Maintaining Step with Sewage Flow Variations. Note Neat Silencer, Heat Exchanger and Piping Layout in Color Scheme Described in Article.

The writer was responsible for the layout plan, and particularly for the placement of the apparatus.

Plans and specifications for 2 70-H.P. engines to be direct connected to 2 8-M.G. pumps, with heat exchangers and gas storage facilities, were approved by the Board of Trustees in the fall of 1935. Plans were accepted by P.W.A. (Docket-Ill.-1392-R), under the 45 per cent grant plan. The contract was awarded December 23, 1935, to the S. J. Reynolds Company of Chicago for $12,235. Engines selected were Climax "Blue Streak" engines, manufactured by the Climax Engine Company of Clinton, Iowa. Installation was started early in January, 1936, and the engines were in full operation March 30, 1936.

Quality of Gas Available

The Aurora gas has about the same composition as sludge gas used elsewhere; averaging 31.8 per cent carbon dioxide, 0.5 per cent oxygen, 3.6 per cent hydrogen, 61.6 per cent methane and 2.5 per cent nitrogen with a "gross" heat value of 633 B.T.U. per cubic foot and a "net or low" heat value of 570 B.T.U. at room temperature. The hydrogen sulphide is low compared with many plants and averages 456 parts per million or 24 grains per 100 cubic feet. No provisions have, as yet, been provided for the removal of the sulphur. This can easily be done with homemade apparatus as conditions indicate the necessity. This necessity has not yet been indicated after six months of operation.

Engines

The 70-H.P. engines selected, while new to the sewage field, have had many years of credible performance in the oil and cotton-gin field. They are heavy duty engines, built for continuous running at 1,000 to 1,200 r.p.m. At Aurora, however, they operate between 500 and 800 r.p.m. They have six cylinders with valves in the head. They are equipped with oil filters and coolers, air filters and safety stop for oil shortage or overheated jacket water. They carry double spark plugs and run on both battery and magneto. They are equipped with starting motor and generator. The batteries are cross-tied through double throw switches so that either battery or generator may serve the opposite engine. They have push-button starting control. Two carburetors are provided, one for gas and one for gasoline. They are so adjusted that one can change fuels without stopping the engine.

The engine controls are unique. The existing motors, on whose modified bases the engines are mounted, were float controlled from the wet well through an automatic switchboard. They were stopped or started according to the flow. The pumps, therefore, delivered an intermitten but fixed flow of 8 to 9 million gallons per day. This scheme was not practical for the

engines. The engine governor was therefore equipped with a drum and screw, acting on the throttle through a lever arm. A cable wound around the drum is counterweighted against floats in the wet well, so that a rising well (increased flows) increases the engine speed and a lowering well decreases it. This drum, therefore, performs the same function as a foot-throttle of a motor car. Under these conditions our 8 m.g. pumps will deliver from 3 m.g.d for the low night flows, at 500 r.p.m, to 12 m.g.d. for storm flows, at about 800 r.p.m. Moreover, the continuous flow to the dosing chambers, versus the former intermittent flow by the former scheme, has much reduced surging through the new secondary settling basins. The new scheme has proved simple, rugged and foolproof. For a change of a million gallon flow rate the well level changes 0.5 of a foot; the engine speed about 25 r.p.m.

One oil change of 5 gallons will carry an engine for 300 hours, and more, before another change is needed. Our annual oil expense will be about $75. The time to change oil is determined by an improvised viscosimeter made from a 50 c.c. pipette, whose tip is adjusted to deliver 50 c.c. of oil in about 135 seconds. Occasionally, an oil test is made on the viscosity of the new and used oil. The oil is discarded when the viscosity changes more than 30 per cent from that of new oil. Great care should be taken to run both oils exactly at room temperature. The test requires not more than 10 minutes and experience indicates that it is a money saver, particularly if care is taken to keep the oil filters clean.

Engine Cooling System

The cooling water for the engine is supplied through two small motor driven pumps tied into an independent closed loop system consisting of the engine cylinders, Whitlock heat exchanger and surge tank. Two pumps insure breakdown protection. The system is kept filled with soft water to avoid scale. It is controlled through a Powers' valve on the engine (set at 150 degrees), which returns water to the pumps until the engine has come to temperature, after which it is admitted to the exchanger. This plan was adopted to maintain a fairly uniform temperature in the engine jackets and to avoid scale formation. A Honeywell-Brown temperature alarm is being fitted into this system to ring an alarm to indicate undue rise of temperature in the engine before this temperature reaches the automatic cut-out point of 200 degrees, which stops the engine. This gives time to determine and correct trouble before engine shutdown occurs due to functioning of the over-heating safety switch.

Silencer and Heat Exchangers

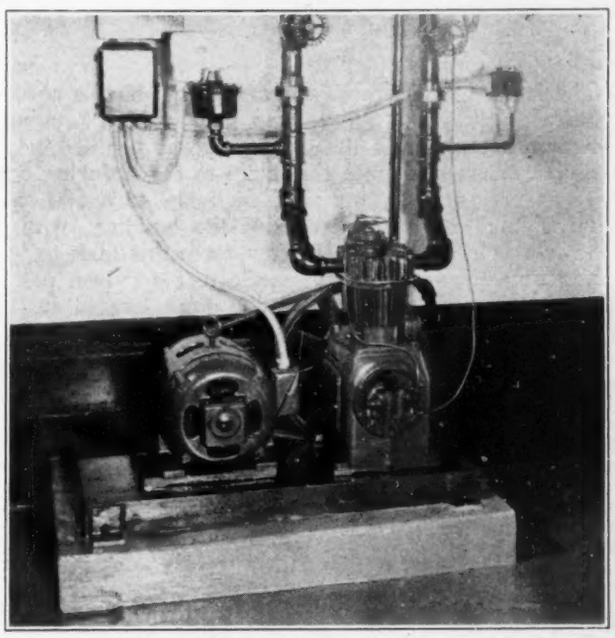
A Maxim silencer of large size was installed near the engines—and, of sufficient size to accommodate a future engine-generator set. Exhaust gases leaving the engine pass through the silencer and then through a Whitlock exhaust gas heat exchanger, before discharge to the atmosphere. Two cast-iron plug-cock valves were placed in the exhaust lines to prevent the back flow of gas and moisture to the idle engine. These are giving excellent service.

The house and digester circulating water is led through the circulating water heat exchanger for first stage of heat, through the exhaust gas heater for the second stage of heat and then returned to the digester system. The original gas furnaces are so arranged, in series with the exchangers, that additional heat, if needed, can be supplied through the furnaces, thus insuring proper digester temperatures at all times. Winter experience is not yet known, but during the summer time no heat was required from the furnaces. The exchange heater is so arranged that any or all of the exhaust may be by-passed around the heater direct to the atmosphere. It was further necessary to equip the exhaust heat exchanger with a positive automatic trap to bleed water formed, since about 80 lbs. of water are produced per 1,000 cubic feet of gas burned. At low speeds, this water is condensed and must be removed through the trap. At higher speeds, the temperature in the exhaust causes the discharge of most of the water through to the outside atmosphere. Temperature rises in the digester water across the circulating water exchanger average 2.9 degrees, and across the exhaust exchanger 2.2 degrees, giving a total rise of 5.1 degrees for a flow of 144,000 gallons of digester water per day. Thus approximately 45 per cent of the total heat (gas to engine) is recovered in the exchangers.

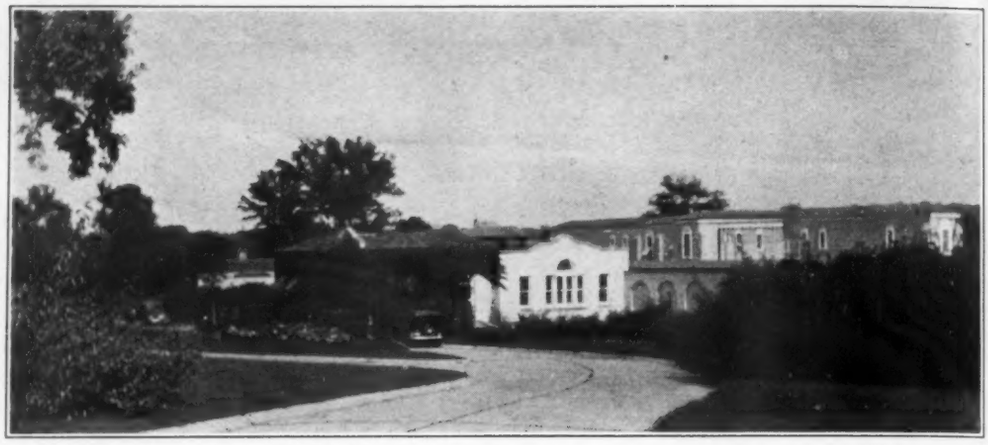
Gas Supply System

Three years ago, for successful gas engine operations, provision of a fairly large volume of stored gas seemed quite necessary. Experience, to date, indicates that less and less emphasis need be placed on provisions for storage. Estimates, in hand, indicate that a 20,000 cubic foot holder, without foundations, would cost better than $6,000, so that the complete holder would run in the neighborhood of $8,000 to $10,000—or a sum nearly equal to our whole installation cost. We decided, therefore, to install a pressure gas holder at a cost of approximately $2,500—a remarkably worth while saving, plus the more pleasing appearance and compactness of the pressure holder.

This system consists of a surge tank 6 feet in diameter and 15 feet long, floating on the line between the digesters and the gas compressor. The compressor discharges to a tank 10 feet in diameter and 40 feet long having a net volume of 3,000 cubic feet, but, at 40 lbs., capable of delivering about 11,000 cubic feet to the engines. The compressor is a duplex cylinder, air cooled machine with a capacity of 32 cubic feet per minute at 40 lbs. The controls are unique. On



Quincy Gas Compressor—Aurora, Ill. 32 Cu. Ft. Per Minute at 40 Lbs. Showing Detroit Lubricator Mercroid Switch on the Suction Side on Left; and Square D Control Switch on the Discharge Side at Right.



"Sperry's Spotless Town" — Aurora's Treatment Works. When Visitors Shown Through by White Uniformed Operator-Guides "See No Evil"; "Smell No Evil"; Later Make Suit Winning Witnesses of More Value in Court Than a Flock of Experts.

the digester side is placed a Detroit Lubricator diaphragm mercroid switch, which may be adjusted to cut-off at as low as 1 inch water pressure. It cuts in at any desired pressure up to 8 to 9 inches of water. This avoids pulling a vacuum on the digesters. In operation, it pumps the digesters down to 1 to 2 inches pressure, stops until the pressure has recovered to 8 to 9 inches of water and then repeats the cycle. On the discharge side is located a Square D switch with adjustable controls. This cuts out the compressor when the tank has reached 40 to 45 lbs. The tank "coasts" down until the pressure reaches 15 or 20 lbs. upon which the mechanism on the suction side is automatically released and the cycle repeated. Its operation has been very satisfactory. Under this arrangement the compressor literally floats on the line under complete automatic control.

Gas from the pressure tank is delivered to the engines through two reducing valves. The first, operating at 5 lbs.; a second, at 4 to 5 inches of water pressure to the engines. After the third day of operation on this system a by-pass was cut directly across from the digester supply to the engines with a by-pass around the low pressure reducing valve. In the first six months, under discussion, the pressure storage has scarcely been used.

Auxiliary Fuel System

The District endeavored to reach a reasonable agreement with the local utility, who have a high pressure gas main running past the plant. It was planned originally to run a line from this main to serve during our low gas periods. Failing this, we installed a 500 gallon gasoline storage tank outside the building, with a level indicator. Gasoline is taken from this tank to the engines by means of an automatic motor driven pump supplying an auxiliary two gallon tank located inside the building. It is so arranged that all gasoline is pumped from the top of the tank, and, therefore, the pump room can never be flooded with more than two gallons of gasoline from this source. This arrangement avoided an insurance penalty. The engines are connected with both gas and gasoline fuel lines direct to the carburetors.

Miscellaneous Items

The general appearance of the system, as installed, is as if it had always been there. All pipe lines are carried around the wall and out to the engine in parallel groups, leaving the pump room with good lines and no suggestion of "make-over."

All piping, except the fuel lines, are covered with 85 per cent magnesia covering. No tendency to disintegrate or shatter has yet occurred, and this includes the exhaust line and silencer.

The differential color scheme of green for engine circulating water, red for fuel lines, black for the exhaust lines and aluminum for house water lines lends distinction and makes the system easy to trace.

The muffling of the exhaust is complete. Vibrations set up by the gas compressor were amplified by the gas tank. This caused a metallic ring to be heard for long distances, which was not anticipated. It was corrected by cutting in rubber connections on the compressor lines to reduce valve telegraphing; and cutting into the discharge line to the pressure tank a home-made muffle, consisting of a 6-inch pipe with baffling plates to control gas pulsation sounds. The scheme was succesful and the operation of the system was made silent.

The engines are easily started on either gas or gasoline. Since they so much resemble automobile engines, anybody about the plant can start or stop them. Whereas we had anticipated that these engines might demand considerable time and attention we have found that properly supplied with oil, water and fuel they require practically no attention from week-end to week-end. They give practically the same continuous running qualities as electric motors. During the clean-up stage the pump room floors were painted and nobody was near the engines for three full days. This has been characteristic of their operation for six months.

A high grade gas meter is part of the equipment giving the daily record of gas consumption.

Performance

This article was intended to generally describe the Aurora installation. The forepart of 1937 we hope to complete the story, in a second article in this magazine, revealing engine performance and the savings effected. Based on six months of operation the following "summary figures" are of interest:

The gross cost of the engines was approximately $12,700, of which we received some $5,600 as a Government grant, making a net cost of $7,100 to the District.

The actual power bills for motor operation, exclusive of light and booster stations (paid by the District in 1935 between April 1 and October 1), was $3,421.54. For the same period in 1936 our power bill, as above, was $859.80. This is a gross saving of $2,561.74 in six months. Against this there is no auxiliary gasoline fuel costs and but 75 gallons of oil, costing $41. Based on twelve months' operation of the filters it is evident, therefore, that the gross cost of the engines will be returned in 2 years and 6 months

and the net cost in 1 year and 3 months, interest and annuities not considered.

The average gas consumption required by the engines has been 586,000 cubic feet per month or 19,300 cubic feet per day as against our estimate of 23,000 cubic feet per day. In 5 years there have been but 8 months with an average total production as low as 608,000 cubic feet of gas, indicating that the occasions for the use of gasoline fuel will be much less than anticipated.

The engines were purchased under a guarantee of 12,000 B.t.u. per brake horsepower hour for full load; 13,000 B.t.u. for ¾ load and 16,000 B.t.u. for ½ load. Tests, to date, indicate the engines to be running well under these figures, averaging from 9,200 B.t.u. for full load to not to exceed 11,000 B.t.u. for ½ load. This emphasizes again the value of the unique manner of controlling engine speed, because the size of the engine as to horsepower and, therefore, its gas consumption, is automatically adjusted to the load. The engine consumes less gas, under these conditions, than under the condition of a fixed speed governor.

Conclusions

All the evidence accumulated from a six-month experience indicates:

A successful design well adapted to our needs.

A dependability, particularly from the standpoint of time required for attention, beyond our expectation.

A very decided saving in costs. Plant operating costs for 5 years have averaged $26,200. This will drop approximately 19.5 per cent.

Less oil and auxiliary fuel costs than anticipated.

Due to variable engine speed the ability to drive the 8 m.g.d. pumps between a range of 3 and 12 m.g.d. gives an unexpected flexibility and economy in plant operation.

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Gene Dugger Boomed for Presidency of A. W. W. A.

E. F. Dugger

Proud of its retiring representative on the Board of Direction of A. W. W. A., the Virginia Section has passed and distributed the following resolution concerning Eugene F. Dugger, a charter member and "wheel-horse" of the Virginia Section, and "live-wire" Manager of the Newport News Water Works:

"In view of the fact that Mr. E. F. Dugger of the Virginia Section of the American Water Works Association is a potential candidate as the next president of the American Water Works Association, the Virginia Section of said Association hereby wishes to give testimony of the ability, energy, and leadership of Mr. Dugger and to endorse unanimously his candidacy. The Virginia Section of the American Water Works Association invites and welcomes the support of the other sections and instructs its secretary to write to the various sections to enlist their assistance. It further instructs its secretary to notify the directors of the American Water Works Association of its unqualified endorsement of Mr. Dugger for the office of President and to inform Mr. Dugger of this action."

It is not strange that Virginians boost a Virginian, but when those Carolina "Tar Heels" to the south endorse a Virginian as their choice for the office of President of the A. W. W. A. that *is* news of the "man-bites-dog" variety. That Gene Dugger has likewise been endorsed through a resolution passed by the long established North Carolina Section, would necessitate a trip to a hat shop by others less subject to flattery or whims than the man who has had to withstand much of this from Newport News Water Commissioners and others with knowledge of his accomplishments.

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Tom Riddick Establishes Riddick Laboratories

T. M. Riddick

Thomas M. Riddick, associated with the firm Nicholas S. Hill, Jr., as Chemist-Bacteriologist, until the recent death of Mr. Hill, has withdrawn from the firm to establish his own laboratories and conduct a consulting practice. The new Riddick Laboratories, modern in every respect, are equipped for all types of municipal analytical work, water, sewage, milk, coal, oil, cement, chemicals, et al. Mr. Riddick and his staff will specialize in supervisory services in connection with the operation of water works and sewerage plants, swimming pools, industrial water supply and waste treatment, and will conduct stream pollution investigations.

Mr. Riddick, a native of North Carolina, got his start and M.S. degree under Dean H. G. Baity at the University of North Carolina. He came to New York University as Instructor in Sanitary Science with Dean Thorndike Saville, bringing a background of research and operating experience. He holds membership in A.W.W.A., A.S.C.E., A.P.H.A. and New York Sewage Works Association.

The Riddick Laboratories, so attractively furnished and ingeniously and modernly equipped as to justify description beyond space limitations in this issue, are to be described by Mr. Riddick in an article especially requested for our next issue. The new laboratories, as full of ideas as is the "proprietor" himself, are located at 369 East 149th St., in New York City.

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Sewerage Developments In New York State

Forty-one sets of plans for sewerage and sewage treatment were approved by the New York State Department of Health in the month of November. Amongst these projects, Greenport, L. I. (pop. 5,000) is to have a new system and treatment works at a cost of $265,000; new systems for Holland Sewer District No. 1 and Lyncourt Sewer District (Salina), at cost of $300,000 for the latter. The village of Scotia will have a new treatment plant with comminutors, separate digestion tanks, and vacuum filters for sludge dewatering.

GROUND WATER FLOWS AND YIELDS

A Method of Theoretical Estimation Confirmed by Actual Pumping Records

By R. L. McNAMEE, C.E.*
Ann Arbor, Michigan

R. L. McNamee

IN CONNECTION with an exhaustive investigation of available ground water resources in glacial sands and gravels for public water supply for the city of Ann Arbor, Michigan, it has been possible to show a sympathetic relationship between the underflows as determined from precipitation, evaporation, transpiration and run-off data and, the actual capturable yield as exhibited by one of the city's present pumping stations.

Bases of Reasoning and Calculations

Underflows were calculated by deductions based upon the principle of the hydrologic cycle. Water upon the earth, wherever encountered, is at some point in a continuous cycle of travel; either precipitation from the clouds to the earth, flow or storage on or in the earth, use by plants and animals, or return by evaporation to the clouds. A part of the precipitation falling as rain, snow or hail, never reaches the surface of the earth but is evaporated directly during its fall or is intercepted by structures and vegetation above the earth from which it is then evaporated to the air. Of that part which does reach the surface of the ground, some immediately runs over the surface, concentrates in streams and ultimately joins the rivers and lakes and seas; another portion is evaporated directly from the ground and is returned thus to the atmospheric form; and, where conditions are favorable, still a third portion percolates into the ground. Many factors, such as, temperature, topography, surface geology, agricultural and other activities of man, natural vegetal cover and seasonal influences, affect the relative proportions which are disposed of in these ways.

That component of the water in the hydrologic cycle that percolates into the ground and comprises the underflow and underground storage is the most difficult of measurement, whether as rates of flow or volumes of storage. It is hidden from view and is dispersed widely both laterally and vertically through the earth's soil and rock structure. If, however, underflow and ground water storage are considered as phases in the complete cycle it is possible to deduce reasonable estimates of their quantities by measurements of water passing through other phases of the same cycle. Precipitation is actually measured at many points. Fairly reliable estimates of the amounts of water evaporated directly from land and water surfaces can be made upon the basis of land and water areas and characteristics. Similarly, the transpiration of water by vegetation can be estimated, once the areas and vegetal characteristics are determined. Surface flows are actually gaged at many points and, the factors influencing such flows being well understood, fair estimates of the flow in streams for which no records are available can be derived by comparative studies with those having gagings. The total supply of water to an area by precipitation less the losses by evaporation, transpiration and surface run-off leaves an amount accountable for only by underflow or underground storage.

*Shoecraft, Drury and McNamee, Engrs., Ann Arbor, Mich.

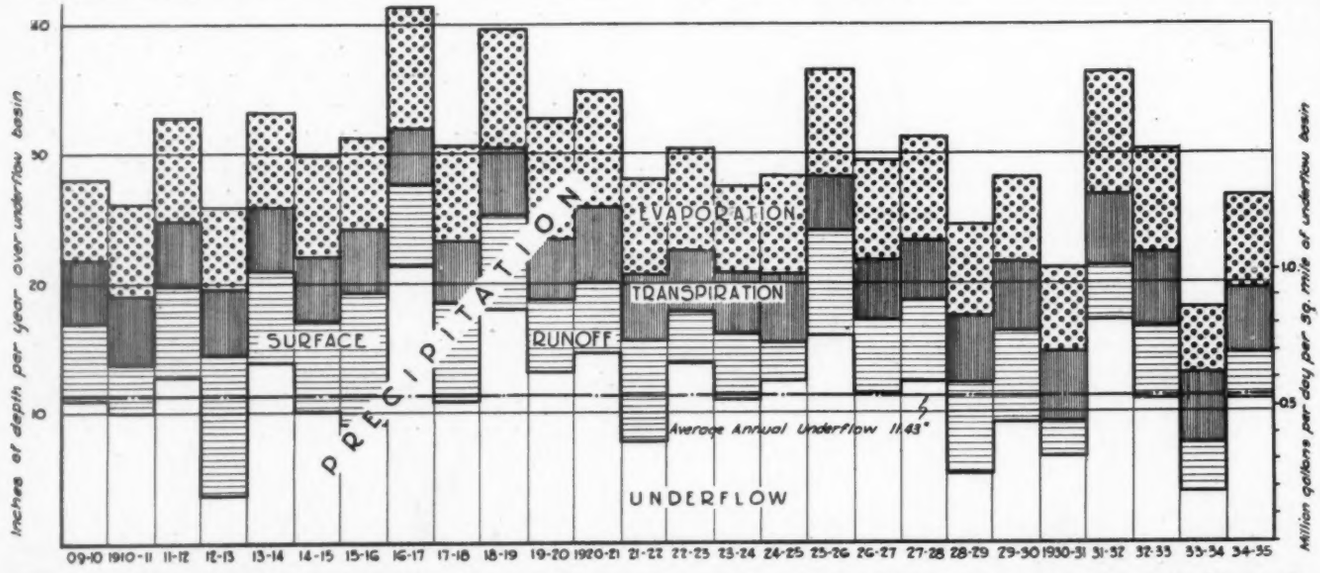

Chart I—Precipitation and Its Disposition in the Vicinity of Ann Arbor, Mich. (Water Years Indicated Are 12 Month Periods, Oct. 1-Sept. 30).

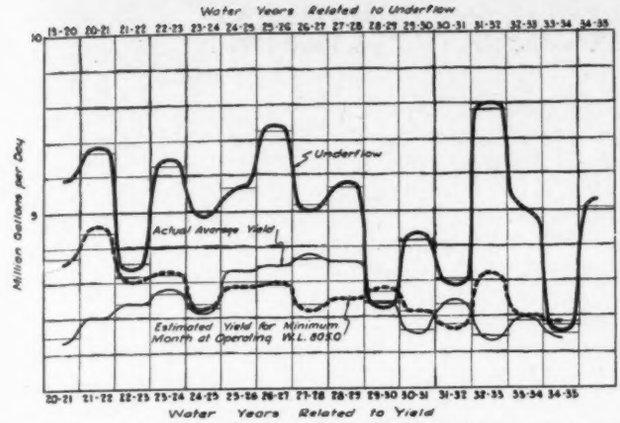
Water Years Related to Underflow
Million Gallons per Day
Underflow
Actual Average Yield
Estimated Yield for Minimum Month at Operating W.L. 805.0
Water Years Related to Yield

Chart II—Probable Underflows and Yields As Predicted on Assumptions and Estimates Vs. Actual Proven Yields (Steere Farm Well Field, Ann Arbor, Mich.)

A Practical Application

This analysis when applied to the region about Ann Arbor, and based upon an actual field survey of the climatological, geological and natural and agricultural factors, has produced estimates of precipitation and its disposition over a period of years in the amounts and rates represented on Chart I.

One of the city's larger pumping stations, locally known as the Steere Farm Station, has been in continuous service since its construction in 1919, and during this period daily records of pumpage and of the operating water levels in the well system have been kept. In connection with the recent study of the underground resources, the area of the underflow basin tributary to the Steere Farm Station was determined, by observations on the elevation of the water table, to be about 9.6 square miles. The probable underflow from this area based upon the annual rates per square mile represented in Chart I for the years 1919 to date (the period of operation of this station) are represented by the solid heavy line of Chart II.

Confirmation

The actual average yield of water by pumpage from the underflow basin at this station is represented by the solid light line on Chart II. The rates of pumpage during these years were influenced principally by the demand for water by the city and they bear little direct relation to the underflows. By an analysis of the operating water levels it has been possible to estimate very closely the estimated yield that could have been drawn at this station at a constant operating water level throughout the 15-year period. Had the station been so operated at a constant water level, the pumpage should then have reflected the available supply underflow. That is to say, a high underflow would have yielded water at a high rate and low underflow would have yielded at a low rate, had the water in the wells been drawn down to a uniform elevation in both periods. The estimated yield as determined for a reasonable common operating water level over the 15-year period of operation of the station is represented by the dashed heavy line on Chart II.

A preliminary inspection of these data discloses that there are wide contradictions between the underflows and estimated pumpages when plotted against each other concurrently, but that these apparent contradictions disappear if an appropriate factor of time lag between them is introduced. This has been done on Chart II, in which the underflow is plotted against the years shown at the top of the chart, while the actual yield and the estimated yield at a common water level are plotted against the years at the bottom of the chart. There must be, of course, a material lapse of time between the precipitation of water upon the earth and its passage as underflow at the lower end or mouth of the underflow basin of appreciable size.

Lag of 12 Months Noted

An analysis of the data available for the Steere Farm well field, interpreted in the light of the underflow studies in general, indicates that there is in this case a lag of about one year between the annual supply and the annual discharge by underflow in the vicinity of the pumping station. This lag, represented in Chart II, brings out clearly the sympathetic relationship between underflow and yield. The years of high and low underflows and of high and low yields are quite agreeable as indicated by the similarity of the curves; or, bearing in mind the one-year lag, by comparison below:

High Years			Low Years		
Underflow	Probable Yield at 805	Lag	Underflow	Probable Yield at 805	Lag
1920-1921	1921-1922	1 year	1921-1922	1922-1923	1 year
1922-1923	1923-1934	1 year	1923-1924	1924-1925	1 year
1925-1926	1926-1927	1 year	1926-1927	1927-1928	1 year
1927-1928	1929-1930	2 years	1928-1929	no low	
1929-1930	1929-1930	0 years	1930-1931	1931-1932	1 year
1931-1932	1932-1933	1 year	1933-1934	1934-1935	1 year

This sympathetic relationship between underflow and yield confirms not only the assumption of time lag between them but also, in principle, the whole theory of the hydrologic cycle.

Similar applications of this method of analysis have been made of the underflow fields of other stations now operated by the city. And, since, to a newly discovered area which gives promise of an enlarged underground supply for the city.

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Wm. E. Stanley Appointed to Cornell Faculty

W. E. Stanley, Jr.

The appointment of William E. Stanley as Professor of Sanitary Engineering in the School of Engineering at Cornell University has been recently announced by President Livingston Farrand.

Mr. Stanley is a graduate of Kansas State College (1912) and Purdue University (1916), where he received the degree of Civil Engineering.

During the last seventeen years he has been a member of the firm of Greeley and Hansen, well-known Chicago firm of consulting engineers, and has had a major part in the development of many municipal engineering projects.

Professor Stanley won the highest award of the Illinois Society of Engineers in recognition of his paper entitled "Cost Considerations in Engineering Design." He is a member of the leading engineering societies and Sigma Tau, honorary engineering society, and Sigma Xi fraternity.

Mr. Stanley's appointment as Professor of Sanitary Engineering brings to Cornell University his many years of experience as a successful consulting sanitary engineer, thus materially strengthening the department which he now heads.

SLUDGE DISPOSAL BY INCINERATION

By PHILIP B. STREANDER

*Watson & Streander**
New York City.

The Author

EVERY method of sewage treatment results in sludge production and the problem of its disposal in the most technically and economically satisfactory manner. In recent years incineration as a method of disposal of sewage sludge has been attracting considerable attention. Preparatory to incineration, for economical reasons, it is essential to remove from the sludge as much of the free liquor as is feasible by mechanical thickening and dewatering. It is also essential to remove moisture from the sludge solids to a point at which the partially dried sludge can be considered a low grade fuel and disposed of as such by combustion. It is the purpose of this series of articles to discuss the various steps involved and point to some of the possibilities for future development in the drying and burning of the sludge. Also to briefly describe equipment now available for sludge incineration.

Part I—Review of the Sludge Disposal Problem

Sewage treatment can be properly divided into two main classifications—(1) the separation of solids from the transporting medium; (2) the disposal of the separated solids. The first of these deals with large volumes and minute concentration, in the approximate ratio of 5,000 to 1, and the second with small volumes and high concentrations ranging in ratio from 10 to 1 up to about 40 to 1 for the thinner sludges. The amount of solids to be removed from the sewage is a function of the degree of treatment (purification) required. This may range from the removal of the larger floating solids by fine screening, amounting to between 10 and 15 per cent of the suspended solids, up to what is commonly designated as complete treatment, requiring practically 100 per cent removal of the sewage solids. The suspended solids content varies from about 100 to 125 p.p.m. in a weak sewage to 175 to 225 p.p.m. for an average sewage up to 300 to 400 p.p.m. for strong sewage. These represent approximately 900 to 3,300 pounds of dry solids (average of about 1,600 pounds) per million gallons of sewage. With plain settling about 800 pounds of sewage solids must be disposed of and for complete treatment this is increased to an average of about 1,500 pounds per million gallons of sewage.

Manner of Separating Solids From Sewage

Due to the low ratio of solids to the sewage, their removal is limited more or less to gravity separation in settling tanks. The use of chemicals to coagulate the otherwise non-settling solids increases the amount of solids removed. Adsorption and flocculation of sewage solids by zoological aggregates and biological oxidation, such as is accomplished by sprinkling filters and the activated sludge process, materially increase the removal of solids above all other methods. Numerous improvements have been and are being made in the mechanics of handling the sludge separated from sewage in settling tanks and, to a lesser extent, in the manner of separation. In the present interpretation of solids separation, it appears that settling tanks will continue as the favored means of securing separation of solids from sewage. If not the sole means, then as preliminary to other mechanical means such as rotating filters, or fixed medium filter beds provided with mechanical means for removing the accumulated solids. Improvements will, without doubt, be made in various methods of treatment, but these will probably constitute refinements of existing methods or further amplifications thereof. Improvements or even radical changes are being and will be made in the second phase of sewage treatment—the disposal of the sludge.

Present Methods of Disposal

From the time that separation of sewage solids was effected from its water carriage, sludge disposal has been an annoying and costly problem. Sewage sludge is an unstable compound and in liquid form is subject to rapid decomposition. Early efforts to side-step the sludge problems resulted in the septic-tank which allowed the decomposition to take place in contact with the sewage and the liquified or peptized solids to pass out with the sewage. Then came the Imhoff system. In the Imhoff tank, gravity separation of the solids constituents was separated from the decomposing sludge with decided improvement. Both of these methods, however, allowed the sludge gas and odors to escape into the surrounding atmosphere and much of the solids to pass out in the effluent. The complete separation of settling tank from sludge digestion chambers—the separate sludge digestion process—constituted the next and important step in the evolution of sewage treatment. The sludge digestion tanks were sealed by floating or fixed covers and the gas resulting from the decomposition of the volatile solids was trapped and used as a source of heat to increase the temperatures in the digestion tank to that required for efficient digestion. More lately the digester gas has been used to operate gas engines for auxiliary power development and in several instances the engine cooling water is being used as the sludge tank heating element, thus allowing the entire gas supply to be utilized by the gas engine. However, with all of these methods there remained, and still remains, the problem of ultimate sludge disposal. Various methods have been used, but probably the most widely established are those of using this material for filling in of low land and as some sort of fertilizer or soil conditioning material.

Disposal by Filling in Lowlands

Sludge used for the purpose of filling in of lowland, either adjacent to or removed from the treatment plant, involves the dewatering and drying of the digested sludge by means of vacuum filters or open or glass-enclosed drying beds. In most instances the area required for the drying beds far exceeds that necessary for the treatment plant. While dumping may, for smaller municipalities, be a partly satisfactory method of disposing of sludge dried to between 60 and 70 per cent moisture, this method is not applicable in larger cities due to scarcity of suitable land at a reasonable distance from the plant. Land used for sludge dumping should be well drained. Comparatively large areas of land must be available for use as sludge dumps. For these reasons it can be generally stated that the practice of dis-

*Consulting Engineers.

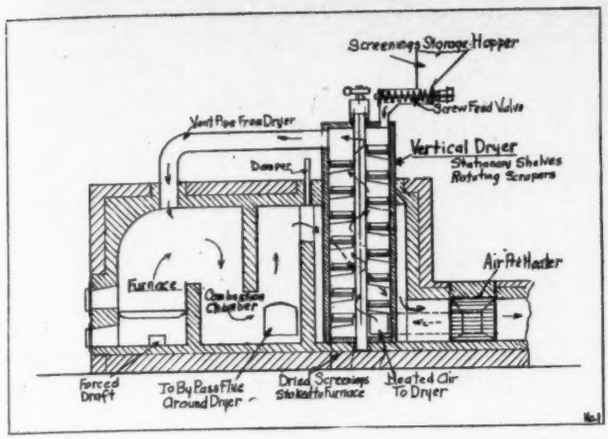

Fig. 1—Outline of Incinerator Proposed in 1916 by the Author

posal of digested sludge by dumping cannot be applied to plants in large cities and further that there is reasonable doubt regarding its application to plants in medium sized cities. The possible exceptions are those plants of comparatively small capacities.

Use as a Fertilizer

The application of fertilizer to soils requires a study of the particular soil and its bacteria, water content, permeability, etc., and the kind of crops to be grown. After such a study is made a fertilizer is specified which has the proper balance in phosphates, potash and nitrogen content. A fertilizer lacking in any of these is unbalanced and eventually causes an unbalenced soil condition. Sewage sludges may, under certain conditions, contain certain ingredients required by the soil, but when this lack is filled continued application will have little or no further value. Certain crops require more nitrogen than other ingredients and for such the application of sewage sludge may be warranted, provided it can be delivered at the point of usage at the same or at a lower cost than commercial fertilizers. In most instances the deficiency of sewage sludge must be supplemented by the addition of lime, phosphoric acid and potash. For these reasons the value of sewage sludge alone is actually much less than the theoretical one.

Modern systems of sewage treatment produce sludge of two general types. The first type is that in which the solids, separated from the sewage by settling, have decomposed (digested) under anaerobic conditions. The second type is that built up in the sewage and temporarily stabilized under aerobic conditions such as happens in the activated sludge process. Naturally the two sludges produced differ materially. Digestion of sludge converts a large portion of the nitrogen into ammonium salts and since the remaining nitrogen containing matter of the sludge has resisted the action of the bacteria during digestion, it cannot be expected to undergo rapid decay when being attacked by soil bacteria. In general, digested sludge is little more than humus for soil conditioning and application to lawns, park grounds, etc., to take up and hold in moisture.

Activated Sludge as Fertilizer

Activated sludge, when converted directly to fertilizer, has a considerably higher value than digested sludge or digested activated sludge. In the undigested the nitrogen contained has not been reduced or changed, the total content as ammonia varying between 4 and 7 per cent. The phosphoric acid content varies between 1 and 3 per cent and the potash content is about ½ per cent. It may be promptly dewatered, dried and ground for use as a fertilizer or as a constituent of prepared fertilizers. Due to the ratio of plant food contents it is particularly applicable to and adapted to lawns, pastures and meadows. It finds its best use as a commercial fertilizer base.

As a commerciad fertilizer development the immense costs involved in the construction of dewatering and drying equipment, with the storage facilities which must be provided due to its seasonal use, increases the cost of production to a point where it exceeds the return from its sale where shipment by rail is involved. It is beyond present comprehension to conceive of numerous municipalities competing with fertilizer manufacturers in the marketing of a comparatively low grade fertilizer product. Should it be economically feasible the sludge products of a group of sewage treatment plants might be disposed of to a centralized fertilizer manufacturer, but such an event is unlikely as the elements contained in activated sludge can in most instances be secured elsewhere at much lower costs. It is to be understood, however, that the ability of a system capable of producing a fertilizer seasonally for local usage may offer attractive possibilities.

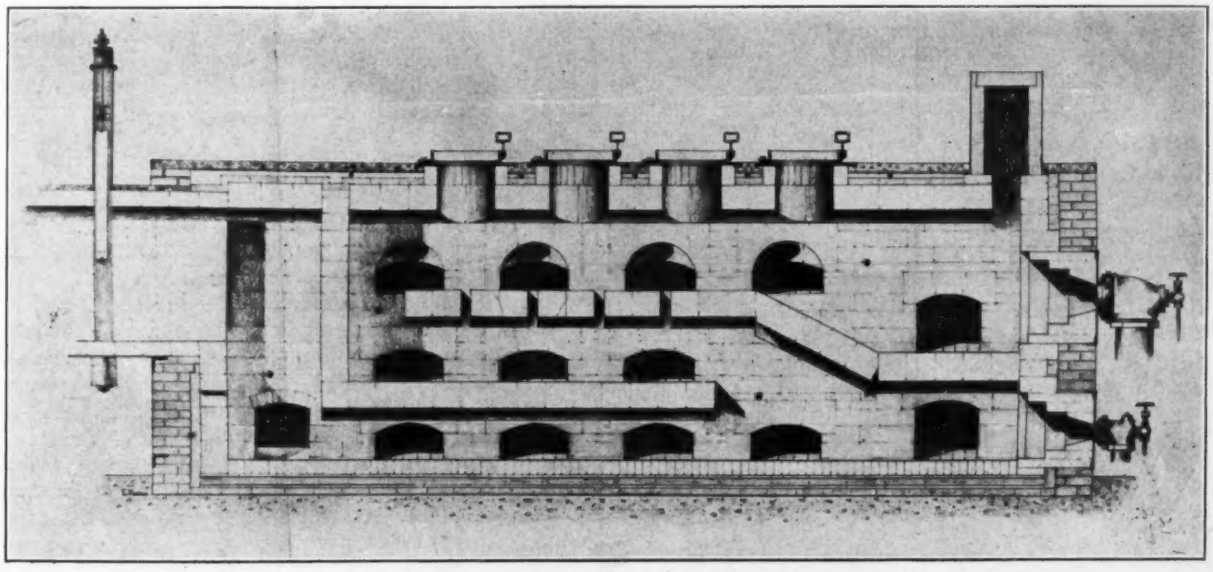

Fig. 2—Morse-Boulger Screenings Incinerator

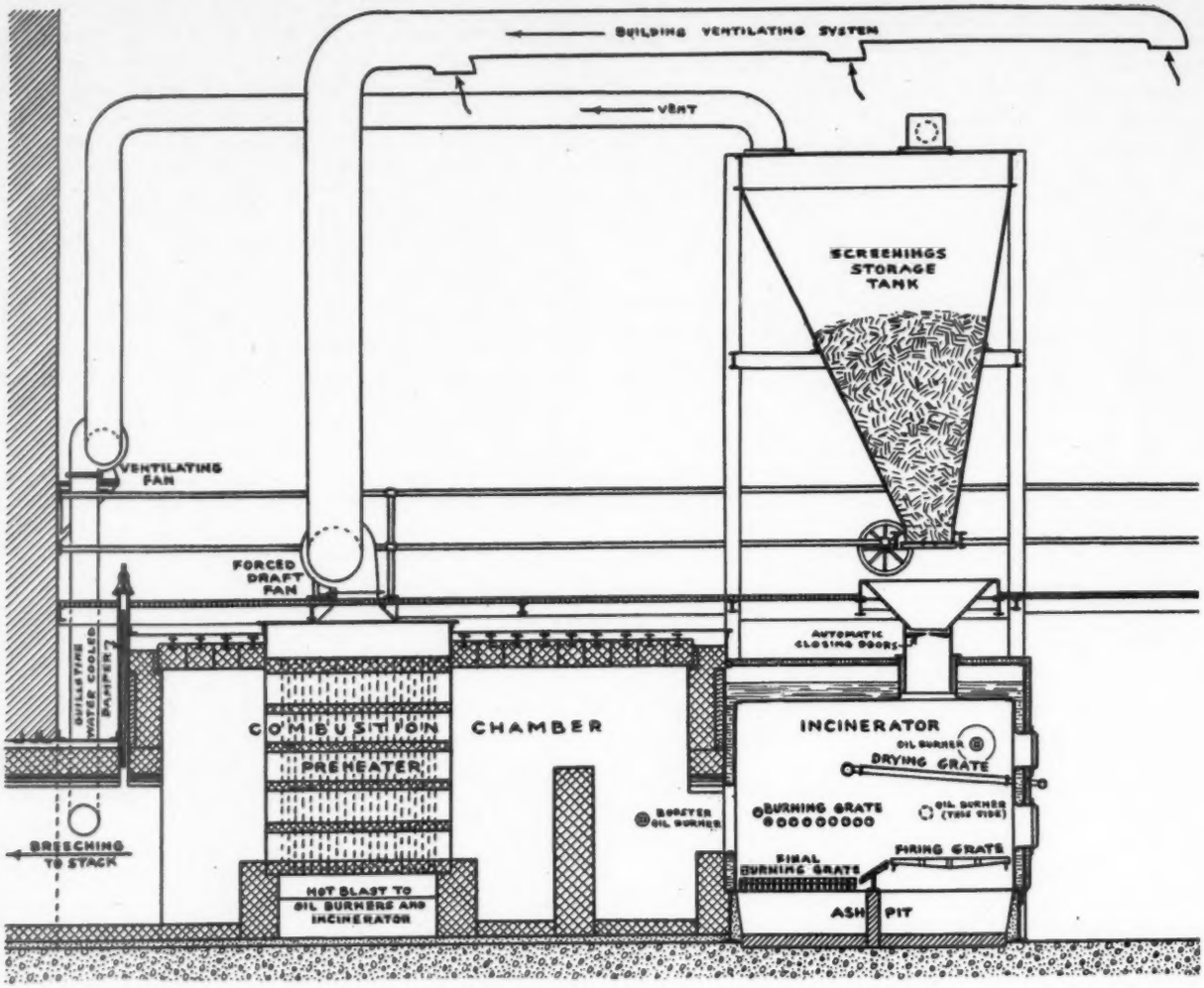

Fig. 3—Decarie Screenings Incinerator

While sewage sludge has been used as a low grade fertilizer, particularly in areas immediately adjacent to sewage treatment plants, the temptation has been to let fertilization of soils become the paramount factor without regard to the possible health hazards involved in its use.[1] There is sufficient evidence in the literature to indicate that communicable diseases may be transmitted from fresh vegetables which are raised on polluted soils. In some of the Oriental and highly populated countries human excreta is used for fertilizer, but with other sources of fertilizer extensively available at low costs such practice is highly questionable in this otherwise enlightened age and time. Even with ideal conditions of sludge application, the practice is definitely foreign to modern sanitary codes.

Mechanical Disposal

The primary object of sewage treatment is the removal of polluting substances and any method which results in sludge production presents problems covering its disposal. Using sludge digestion tanks for anaerobic decomposition stabilizes the resultant product, but does not solve the problem of ultimate disposal. Filling of lowland, using dewatered sludge, is not a proper solution and its application to growing vegetables is a source of potential danger. The dewatering and drying of activated sludge entails extensive plant construction costs and excessive costs in the producing of what is at the best only a low grade fertilizer for local usage.

In view of these conditions it is interesting to observe the seemingly growing trend toward mechanical dewatering of sludges and their final destruction by incineration. Such a trend is readily understandable when an analysis is made of the problems involved in the sanitary disposal of this product. Great strides have been made in the mechanization of sewage treatment which should be followed by improved methods of final sludge disposal. Such methods should be carefully studied in order to arrive at not only the most sanitary method of sludge disposal but also what may in the final analysis be eventually the most economical one.

Part II—Development of Incineration

Numerous efforts, dating back 25 to 30 years, have been made to successfully burn sewage sludges, both in this country and in Europe. In England several plants have used filter presses to dewater the sludge, after which it was mixed with coal and fired into boiler furnaces or into refuse destructors. In Frankfort, Germany, up to the breaking out of the World War, the sludge was pumped from the settling tanks into storage tanks located above centrifugal dewatering machines After centrifuging, the dewatered sludge cake (about 75 per cent moisture) was discharged into drying drums in which it came in contact with hot gases from a refuse destructor plant. Having thereby reduced its moisture content to about 25 per cent the product was then discharged into the refuse destructor and burned without additional fuel.

In this country disposal by burning has been practiced to a considerable extent, particularly in the incineration of fine screenings. At the original installation in Reading, Pa., fine screenings from the Weand screens were burned with an admixture of coal in an ordinary boiler furnace. Long Beach, Cal., in 1916 installed a Morse oil fired incinerator to dispose of its screenings. This incinerator consisted of fixed drying and burning hearths with evaporating pans, etc. In operation considerable oil and manual stoking labor was required to destroy the screenings. As a result of this operating experience, the writer in 1916 made extensive studies of various crematories, incinerators and destructors, covering some twenty types, in an endeavor to ascertain whether or not certain features of these could be combined in a unit which could economically incinerate wet screenings or raw sludge. As the temperature of evaporation is considerably less than the temperature of combustion, it was indicated that a more economical installation could be made if the functions of drying, or evaporation, and burning were separated. The general type and arrangement indicated for such a unit is shown in Fig. No. 1, in which the wet sludge or screenings were fed into the top of a multi-hearth, mechanically rabbled dryer. Hot gases from a preheater passed through the dryer to evaporate the moisture in the sludge, and this moisture laden air was then passed through the combustion chamber for odor destruction. The dried sludge was to be hand fired into single or multiple hearth destructors and burned. At the same time this study was made (1916) the commercial possibilities of sludge or screenings incineration were extremely limited and nothing was done covering its further development. It is interesting to note, however, the closeness of the conclusions reached in this study with some of the features contained in the more successful present day incinerators.

Screenings Incinerators

A number of incinerator installations were made between the years 1925 and 1932 for destroying fine screenings. Of especial note are the several plants in Westchester County, N. Y.,[2] grit and fine screenings incineration at Milwaukee, Wis.; the Los Angeles fine-screenings incinerator.[3] A number of smaller plants were built for incinerating skimmings and coarse screenings. All of these incinerators were of the fixed drying and burning hearth construction, in which auxiliary fuel is used to evaporate the moisture in the screenings and bring them up to the temperature of combustion. All involved hand stoking. This type of incinerator is illustrated by Fig. No. 2 showing the Morse-Boulger furnace, Fig. No. 3 showing the Decarie furnace with suspended water cooled pipe drying hearth and the fixed

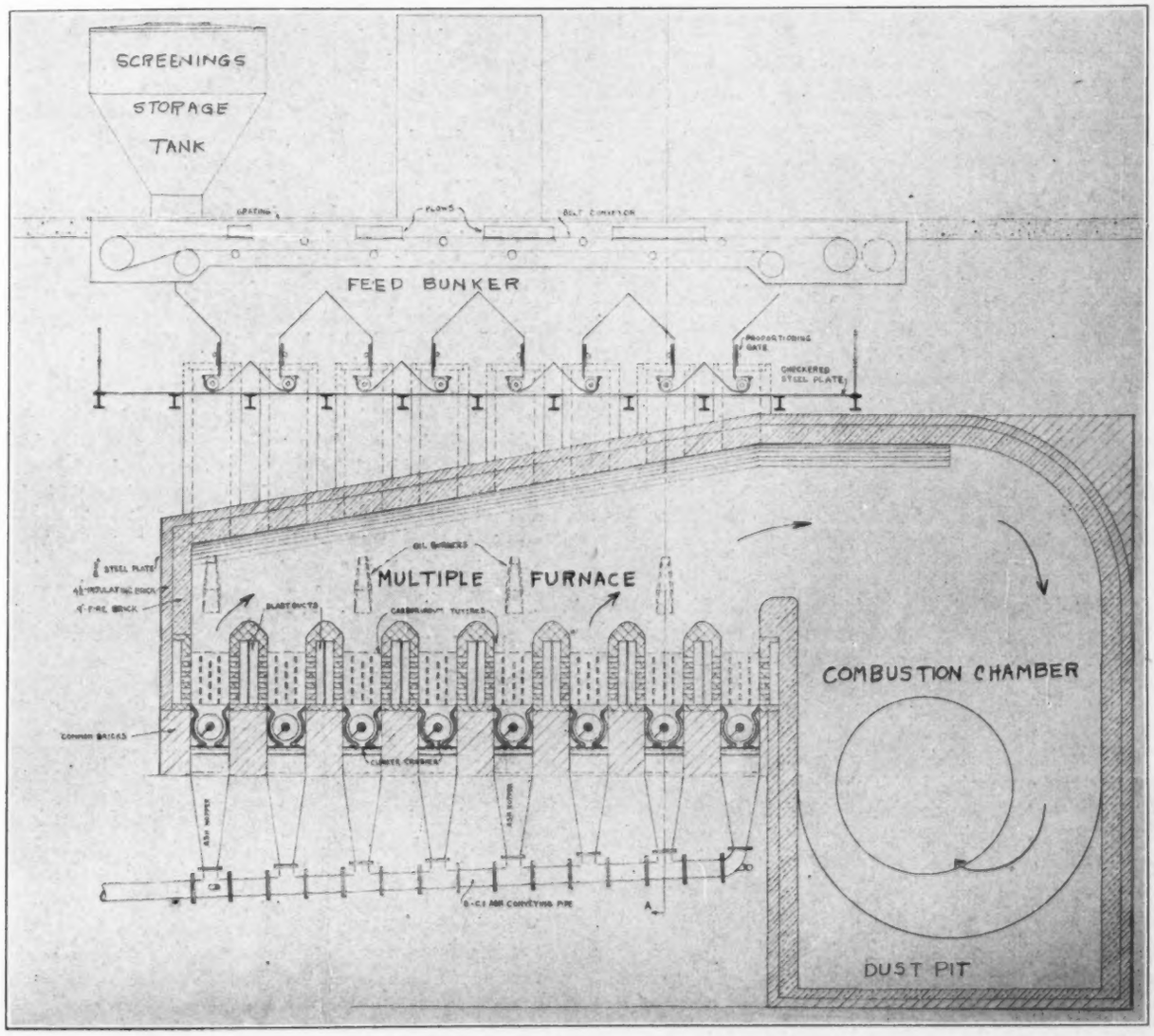

Fig. 4—Borge Screenings Incinerator Longitudinal Section

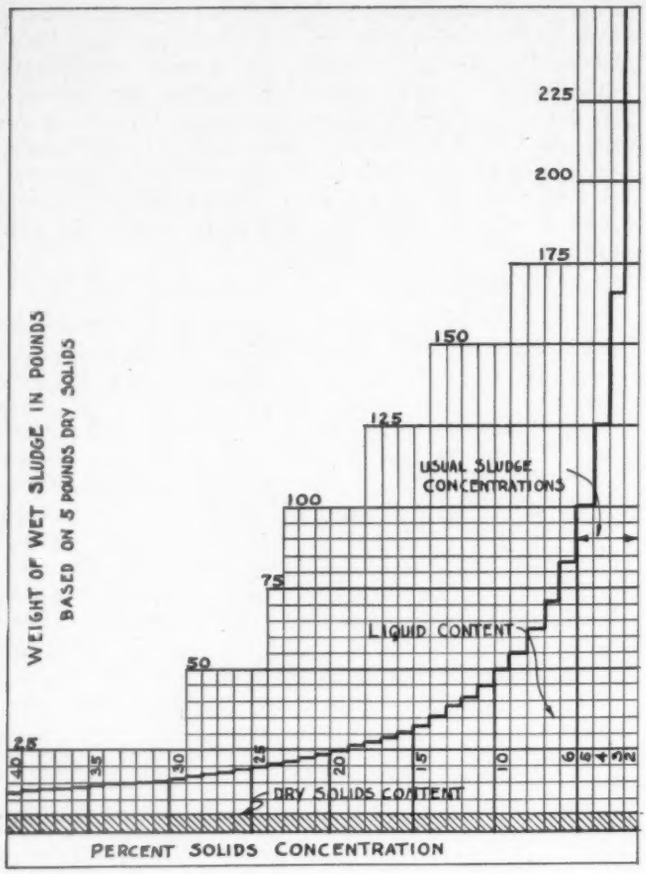

Fig. 5—Effects of Solids Concentration on Sludge Volume

burning grate, and Fig. No. 4 showing the Borge fixed type drying and burning grates with tyures for the blowing of a heated air supply to the screenings. In a few of the installations mechanical devices were used as a means of extracting some of the free liquid from the fine screenings as instanced by roll presses at the Los Angeles and Westchester County plants and centrifugal extractors at the Milwaukee plant. The types of incinerators used in these installations, which serve the purpose intended for the destruction of screenings, cannot however be considered as a type which can be successfully used in the burning or incineration of sewage sludges.

Sludge Incinerators

The problem of sludge incineration was given careful study in Chicago in 1931 and an experimental installation was made to work out its feasibility.[4] Vacuum filters were used to dewater the mixture of raw and activated sludge to a moisture content of about 80 per cent. The dewatered sludge cake was then discharged into a horizontal drying drum in which a large portion of the liquid was evaporated. The dried sludge was then burned in a separate combustion chamber, the hot gases being used to supply heat to the drying drum. Operating troubles developed in the drying of the sludge and the control of odors. This was followed by further experimentation from which the present Calumet (Chicago) incinerator plant installation was developed. The principal feature of this installation is the flash drying of vacuum filter dewatered sludge cake and its combustion in suspension in a separate furnace.[5] In 1934 Dearborn, Mich., installed an incinerator[6] for the destruction of a sludge derived from the chemical treatment of sewage. This incinerator was a development of the well known Herreshoff ore-roaster used successfully in the metallurgical industries for the roasting of ores. It is of the vertical, multi-hearth, mechanically rabbled type in which drying takes place on the upper hearths, followed by complete burning on the lower hearths. Prior to incineration the sludge is dewatered on vacuum filters to a moisture content of about 65 per cent. The development has been highly successful. Other developments are under way consisting of modifications of the Herreshoff type furnace and others in the separate drying and combustion of the sludge. These incinerator installations, and those being developed, are all based on the self evident requirement that evaporation of moisture uniformly from the moist cake must be done as a preliminary to the successful and uniform burning of the sludge. The various incinerators above mentioned are to be described in more detail in the next installment of this article.

Part III—Gravity and Mechanical Separation of Free Liquor

In this discussion of dewatering and incineration, the word *solids* will mean the sewage solids contained in the sludge *computed on a dry basis* and the words *sewage-sludge* will mean *the actual wet product* resulting from the treatment of the sewage. Rather than use the common designation of moisture content to indicate the amount of moisture contained in the sludge, there will be used the term *sludge-density* or *solids-concentration* to indicate the amounts of solids in the sludge. Such a designation is more readily understandable, because a sludge having a solids concentration of 5 per cent will be double the volume of the same or another sludge having a concentration of 10 per cent. That is to say, the liquid content of a 5 per cent sludge will be about double that of the sludge having a concentration of 10 per cent. The influence of the solids concentration on the volume of sewage sludge is shown graphically in Fig. 5. This figure is based on 5 pounds of sewage solids, under various concentrations, ranging from an assumed economical maximum of 40 per cent down to 2 per cent, which is that usually secured in the form of activated sludge. The solids concentration of sludge, ordinarily derived from the treatment of sewage, ranges from a low of 2 per cent for waste activated sludge to 5 per cent for plain settling tank and chemically precipitated sludge. Referring to Fig. No. 5, it can be readily seen that the liquid portion of the sludge containing the assumed 5 pounds of sewage solids will be 245 pounds for waste activated sludge and 95 pounds for the plain settled sludge.

Gravity Separation and Concentration

Sewage sludge, as taken from settling tanks, is that which has been separated from the sewage by settling under the forms of gravity, usually with comparatively short detention periods. Such sludges usually range between 4 and 6 per cent concentration for plain-settled, or raw sewage sludge, and between 1½ and 2 per cent for activated sludge. Sludge thickening or concentration has been used in practice for many years in tanks where the supernatant liquor was decanted from the surface level. Installations of sludge thickeners to increase the concentration of the sludge, such as that at Phoenix, Ariz., have demonstrated that such thickening is feasible and controllable. Individual particles of sludge lie loosely on top of each other and for this

reason large amounts of water form in the hollow spaces. When a slowly revolving mechanism passes through the sludge the particles are moved and the water between is displaced, the heavier sludge sinking to a lower level and the liquid rising toward the top. The detention period required to effect thickening varies between 12 and 48 hours, the shorter period being normally the minimum and the higher being controlled largely by setting in of septic action in the sludge, unless it is treated with a disinfectant of some nature.

Data, taken from operating results in installations and from experimental work, indicate that a raw sludge having a concentration of between 4 and 5 per cent can be increased by thickeners to between 8 and 10 per cent, corresponding to a volume reduction of about 50 per cent. Activated sludge can be increased from an initial concentration of 1½ per cent up to between 4 and 6 per cent. Such increased concentrations materially increase the capacity of vacuum filters or centrifugal clarifiers used to effect a further increase in solids concentration. Also the effect of concentration is very helpful in the operation of sludge digesters.

Mechanical Removal

The balance of the liquid in thickened sludge, or in sludge the density of which has been increased to its optimum under gravity conditions, still contains a large amount of liquid. In this discussion this liquid will be referred to as free and inert, the free liquid being that portion which can be more or less readily removed by mechanical means and the inert liquid being that portion held in the cells and fibres of the organic material by the moisture capillarity of the sludge solids, which can only be removed by heat or thermal evaporation.

The extent to which the free liquid can be removed from sludge has been amply demonstrated by vacuum filter dewatering installations and to a lesser, but by no means a less positive extent, by centrifugal dewatering machines. Vacuum filter dewatering, using chemicals for preparing sludge conditioning, indicate that the solids concentration can be increased to between 25 and 30 per cent for raw sludge, to between 30 and 35 per cent for chemical sludge, and about 20 per cent for activated sludge. Centrifugal dewatering of sludge, without the use of conditioning chemicals, indicate that sludge concentrations can be increased to between 30 and 40 per cent for raw sludge, an estimated 35 to 40 per cent for chemical sludge, between 15 and 20 per cent for activated sludge and 25 to 30 per cent for mixtures of activated and raw sludge.

Volume of Liquid to Be Removed

The amount of liquid to be removed by mechanical means, where power is not to be produced, is that required to increase the sludge density to a point where the heat necessary to evaporate the liquid is slightly less than that produced by the combustion of the sludge. This is variable depending largely on the combined efficiency of the dryer and burning compartments of the incinerator. It may be stated that for low capacity installations it may be more economical to dispense with mechanical dewatering equipment and provide the additional heat necessary to evaporate the excess moisture by auxiliary fuel. However, this is a matter which can only be determined by comparative cost estimates of fixed and operating costs. Under the prevailing methods of bidding on municipal work these computations may be of little or no value unless guarantees are inserted covering performance and duties required. It can be generally stated that mechanical dewatering in excess of the thermal requirements of evaporation and burning is wasteful in capital and operating costs, because then no benefits accrue in reductions beyond actual requirements. In plants where waste heat may be utilized for the generation of steam, computations of operating labor, power costs and the costs of conditioning chemicals must be carefully made and balanced against the revenue secured by the generation of steam for power purposes. Such balances are largely affected by prevailing electric power rates.

Power Required for Mechanical Dewatering

Power required to mechanically dewater sludges depends largely on the initial and final sludge densities and also on the type of sludge handled. Vacuum filters will pass large volume of liquid at low density, but as the density increases the volume passed becomes less. Raw primary sludge increased from an initial density of 10 per cent to a final density of 30 per cent requires one K.W. for about each 400 pounds of liquid removed. Raw activated sludge, increased from an initial density of 4 per cent to a final density of 20 per cent, requires one K.W. for about each 700 pounds of liquid removed. The maximum final density produced, however, is not directly a function of the power input, but is rather controlled by the cohesion of the sludge cake and its ability to withstand cracking and crazing under high vacuums, which is a function of chemical sludge conditioning. When computing the costs of dewatering on vacuum filters there must be added to the cost of power the costs of the conditioning chemicals, which for average conditions is about twice the power costs.

Unlike vacuum filters, the amount of liquid removed by centrifugal dewatering machines and the final density of the sludge is a function of the power input. This is generally shown in Fig. 6 which is based on an initial sludge density of 10 per cent and gives the approximate number of pounds removed per hour per K.W. input for the final concentrations indicated. This gives about 350 pounds of liquid removed per K.W. when the final density is 30 per cent and only about 125 pounds when the final density is increased to 40 per cent. Therefore. it requires about three times as much power to secure a density of 40 per cent than is required for a density of 30 per cent—a 300 per cent power increase for a 10 per cent density gain. In the dewatering of 10,000 pounds of wet sludge having a density of 10 per cent and increased to a final density of 40 per cent about 60 K.W.H. would be required to remove 7,500 pounds of liquid. When the final density is reduced to 30 per

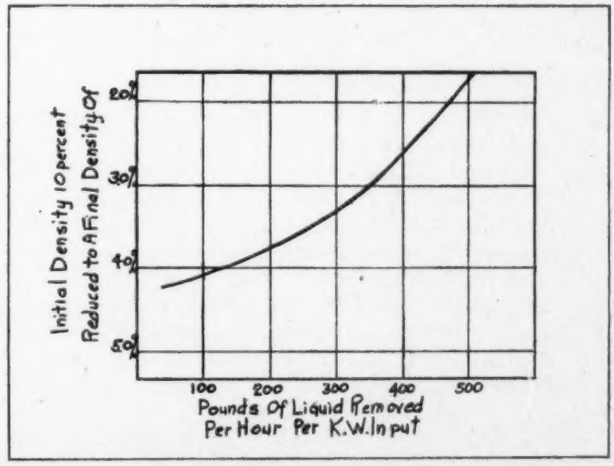

Fig. 6—Power Requipment Mechanical Dewatering

cent about 20 K.W.H. would be required to remove 6,700 pounds of liquid, or 40 K.W.H. is required to remove the 800 pounds representing the difference between 30 and 40 per cent final density—i.e., one K.W. for each 20 pounds thus removed per hour. When the initial density is less than 10 per cent there are more pounds of liquid removed per K.W. input, this however depends somewhat on the type of the centrifugal machine. The removal per K.W. input is also influenced by the type of sludge, but little data is available on which to base the conclusions on this point.

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[2]Water Works and Sewage—June, 1932.
[3]Civil Engineering—June, 1934.
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(To be continued)

"Vic" Ehlers in Line for Presidency A.P.H.A.

V. M. Ehlers

At the recent New Orleans Convention of the American Public Health Association, Victor M. Ehlers, Chief Engineer of Texas' State Department of Health, was elected Third Vice-President of the Association—the first Sanitary Engineer to be placed in the position of becoming President of A. P. H. A. since the late George W. Fuller served in this position.

"Vic" Ehlers is highly deserving of this recognition, having pioneered and spent the best years of his life in Public Health Engineering, during which time he has made the paths of a succession of Texas Health Commissioners' far easier ones. To "Vic" Ehlers, also goes credit for having many years ago established, in Texas, what is believed to be the first Water Works Operators Short School, a pioneering effort which early proved the merits of the undertaking.

"Vic," an adopted son of the Lone Star Country, is a Texan through and through. If you want to know how he stands, just travel through Texas with this "warhorse" sanitarian; diplomat; politician; good fellow—of whom there is no "whommer"! A. P. H. A. honors itself, in honoring "Vic" Ehlers.

Something New in Public Health Engineer Training

From the University of Michigan has been received advice that two new courses, of especial interest to engineers in public health work, and those intending to enter such work, are being added to those now offered by Michigan's Division of Hygiene and Public Health.

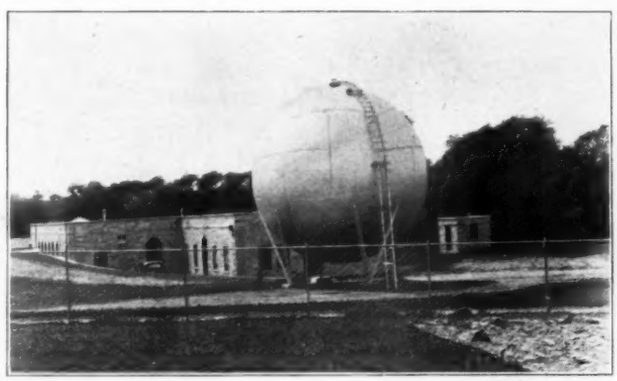
These new courses are to be given under the direction of Harry E. Miller, former State Sanitary Engineer of North Carolina, and more recently Sanitary Engineer with the U. S. Public Health Service. They are therefore designed on an eminently practical foundation, to supply the needs of sanitary engineers in state or local health department work. One course (C. E. 37) covers "State Health Deparmtent Engineering Practices." The other, a companion course, covers "Public Health Engineering Laboratory."

According to letters from Dr. John Sundwall, Director of the School of Public Health, and Professor Miller, "These courses are being developed to broaden the scope of engineering in health work and better equip the engineer to plan, develop and administer public health activities." Professor Miller, in his straightforward manner, very aptly puts it when he says, "It is our plan to offer present and future health department engineers, who take these courses, some *practical slants on what it's all about.*" The italics are ours for the purpose of directing attention to the fact that no one we know of in public health training work has the background and experience which better fits him to give such courses than has Harry E. Miller. Especially interested should Chief Engineers and Directors of Health Departments be to send one or more of their engineering staff to take the new and practical courses, offered by the University of Michigan.

Beaver Dam, Wis., Proud of Its New Treatment Works

Beaver Dam, Wis., has a sewage treatment plant, financed through the PWA, of which it can well be proud.

The flow of sewage averages 1.4 m.g.d., but the industrial loading is equivalent to a population of 25,000 persons added to the domestic population load of 10,000 people. The plant provides secondary treatment, sprinkling filters of 128 ft. diameter with rotating distributors serving the purpose.



Spherical Gas Holder Adds Interest to the New Sewage Treatment Plant, at Beaver Dam, Wis.
A. C. Brumley

From heated digesters (85° F.) with floating covers, the valuable sludge gas is pumped into the space-conserving and attractive appearing 29½-foot diameter Hortonsphere gas-holder operating under maximum pressure of 40 lbs. per sq. in. (see picture). A gas compressor, delivering to the spherical holder, operates automatically to start at a gas pressure of 7 inches of water under the floating cover and cut out when reduced to 2 inches. All gas lines are effectively trapped to preclude possible flame travel back to the compresser. From the Hortonsphere the pressure of the gas leaving is reduced to 7 inches water head again and supplies a fuel for incineration and heating. So far Beaver Dam has not installed a gas-engine but the pressure gas-storage sphere renders this a feasible use of the gas, with additional operating savings to those already recorded.

The plant was designed by the Jerry Donohoe Engineering Co. of Sheboygan, Wis.—the gas holder by Chicago Bridge and Iron Works.

COMPOUND WEATHER AND CLIMATIC CYCLES

By HALBERT P. GILLETTE

IN A PAPER read before the American Meteorological Society, June 26, 1935, I advanced the hypothesis that many weather cycles are harmonic with the earth, orbital period and that they combine with the 12-month cycle to produce compound cycles of great length. For example, I believed that a basic cycle of $103/18 = 5\ 13/18$ years in length caused a compound cycle of 103 years. Subsequently I found that this basic cycle is $63/11 = 5\ 8/11$ years, and that it had a rainfall maximum Dec. 22, 1893, at the time of a maximum of a cycle of 63 years. Hence the compound cycle is 63 years. It will be noted that in this case the supposed harmonic factor, 18, is an even number, whereas the actual harmonic factor, 11, is an odd number. Upon further study of the problem it became evident that if a compound cycle were to attain much amplitude, the harmonic factors should always be odd numbers. For simplicity, let us take a compound cycle of 48 months. At first sight it may seem that it might have a subcycle of half its length or 24 months; but if it did, there would be a peak in the very center of the 48-month curve; whereas if the subcycle were 16 months (the harmonic factor being 3), then a valley of the 16-month cycle would occur at a valley of the 48-month curve, and the amplitude of the curve would thus be increased. Based upon this reasoning, a search was made for compound cycles built up by subharmonic cycles in which the harmonic factors are odd integrals, such as 3, 5, 7, 9, 11. The results of this search have been very surprising.

In the paper above mentioned I announced a cycle of 1825 years, whose subharmonic cycle seemed to be one of $1825/12 = 152\ 1/12$ years. Obviously I had erred as to the latter if harmonic factors are always odd numbers. This led to a review of the data (tree-rings and clay varves); and to the finding of better evidence for a cycle of 140 years than for one of about $152\ 1/12$. This in turn led to a search for the subharmonic cycles that produce a cycle of 140 years. Four of these subcycles were found, namely cycles of 140/35, 140/17, 140/11 and 140/3. All four had coincident sequoia tree-ring maxima in 1866. The $140/35 = 4$-year $= 48$-month cycle had its peak at the December solstice of 1865. But since heavy winter storms in the Sierra Nevada's would cause greater than normal thickness of sequoia rings in the following summer of 1866, it seemed to follow that all four of the subcycles above mentioned had coincident rainfall maxima Dec. 22, 1865. This inference was confirmed by finding that all short rainfall cycles that are harmonics of the 12-month cycle have peaks that occur at the winter solstice. For example, there is a cycle of 1/15 year $= 24.35$ days that has a peak at the winter solstice. This cycle is largely responsible for the short Indian Summer near the middle of November and for the brief "January thaw" near the close of January.

Cycles of 5 and 7 years are to be found in the sequoias, and Halbert S. Gillette has found them in the varves of the Ice Age. These cycles also are harmonic with the 35-year and 140-year cycles.

Having found the 140-year cycle, it became evident that it might be a subcycle of the cycle of approximately 1825 years if the latter were exactly 1820 years, for $13 \times 140 = 1820$. In this case it would require still another subcycle to explain the cycle of 1820 years. It might be one of $1820/5 = 364$ years, or one of $1820/7 = 260$ years, but it could not be one of $1820/4 = 455$, for the harmonic factor of the latter is an even number. I recalled that Turner had found evidence of a cycle of 260 to 280 years in sequoia tree-rings, Nile floods, Chinese earthquakes and declination of the magnetic needle; and that Newcomb had found a cycle of similar length in the aberrations of the moon's apparent motion, the latter probably being due to a periodic change in the oblateness of the earth, which would change the length of the day. So I inferred that there might be a cycle of precisely 260 years. I found it first in the sequoias and then in the annual silt laminae (varves) of the Ice Age measured by Antevs.

Based on my hypothesis of compound cycles, the 260-year cycle must have at least one subcycle other than the 12-month cycle, and it turned out to be $260/11 = 23\ 7/11$ years. In my paper of June 26, 1935, I had called this cycle $23\ 5/6$ years. The error was less than 1%; but it was an error that was fatal to my earlier attempt to find a comprehensive system of harmonic cycles.

Since the 140 and 260-year cycles had coincident rainfall peaks in December 22, 1725, that date is the last peak of the 1820-year cycle. The 1820-year cycle is well shown by prominent moraines during the last Ice Age, by terraces in river valleys, by raised sea-beaches, and by a series of floors of calcium carbonate in certain limestone caves. The 140-year cycle shows similar effects on a smaller scale. Its amplitude is greater than that of the 100, 260 and 270-year cycles, because more subcycles have cooperated to produce it. The 140-year cycle is mainly responsible for increasing temperature and decreasing rainfall during the last 70 years.

Having established that short harmonic cycles are capable of generating one of as great length as 1820 years, there was no reason why much longer cycles might not be similarly produced, even up to cycles millions of years in length. Corresponding to the least common multiple of any two compound cycles there should be a compound cycle of still greater amplitude if the harmonic factors are odd integral numbers. In my paper of June 26, 1935, I pointed out that, as a rule, the longer the cycle the greater the up or down swing (amplitude) of its curve. The reason for that peculiarity is now clear, and it is also clear why there are certain exceptions to the general rule, such as the 140-year cycle, when a greater number of subcycles are involved in producing a compound cycle.

The following are 7 important compound cycles that combine to produce longer ones, their respective lengths in years being exactly: 35, 49, 63, 100, 140, 260 and 270. Their least common multiple is 1,719,900 years, and they had coincident peaks Dec. 22, 91,095 B.C. It would be impossible to determine any such remote date of rainfall maximum with accuracy, were it not for the harmonic

relationship of the short subcycles. The thought naturally suggests itself that 91,095 B.C. may have been the time of the maximum crustal uplift, or "geological revolution," that divided the Pleiocene from the Pleistocene period.

That there is a geological cycle of the order of 1,700,000 years was shown by Prof. L. D. Stamp ("Seasonal Rhythm in the Tertiary Sediments of Burma," Geological Magazine, 1925, p. 515-528). He measured enough annual varves to enable him to determine that about 2,500,000 years were required to deposit all of the rocks of the Oligocene and half of the Miocene Period in Burma. This is equivalent to about 1,700,000 years per Geological Period. He said: "A million years has sometimes been regarded as a mere bagatelle in geological time. In Burma it has been sufficient for the deposition of between 5,000 and 10,000 ft. of sediment. The duration of the Oligocene and half of the Miocene is probably in the neighborhood of 2,500,000 years."

In discussing Stamp's paper William W. Ruber (Professional Paper 165, U. S. Geol. Survey, 1930) said: "Stamp's results seem to accord with the writer's in suggesting that the estimates (of rock ages) based on lead-uranium ratios . . . may be too long or that inconspicuous stratigraphic breaks may be very common."

Seven years ago in "Engineering and Contracting," I suggested that the lead-uranium formula for rock-ages may be grossly erroneous because the helium that is a product of the disintegration of the uranium accumulates in the rock and may accelerate that disintegration. The evidence of the varves in rocks has shattered the reliability of any existing atomic disintegration formula for measuring the ages of rocks.

If helium hastens disintegration of uranium, may it not point the way toward effecting the artificial disintegration of certain atoms with an accompanying production of great energy in an economic manner?

There is good evidence of a cycle of about 26,000 years, presumably due to the gyration of the earth's axis. That cycle is not harmonic with the earth's orbital period, and therefore is not harmonic with any of the cycles above mentioned. Yet they may all have the same basic cause, namely periodic variations in the number of solar electrons that enter our atmosphere. Harmonic gyration of electron-shells that encase the earth would produce not only the short but the long cycles above mentioned, excepting the 26,000-year cycle; and such gyrations would cause periodic variations in the number of solar electrons that enter these electron-shells, which in turn would affect many terrestrial phenomena including weather. Similarly the gyration of the earth's axis would cause a weather cycle of about 26,000 years.

About 16,400 B.C. the axes of earth and sun were nearly in the same heliocentric longitude at the solstices, about June 22 and Dec. 22, with opposite poles of earth and sun pointing most directly toward one another. Since electrons emitted by the sun would spiral around its magnetic axis toward both poles, they would have magnetic polarity corresponding to that of the pole whence they escape. Hence they would be most attracted by the opposite magnetic pole of the earth, as well as that of each rotating electron-shell that encases the earth. This would give to the 26,000-year weather cycle the same basic cause as that of the cycles due to gyrating terrestrial electron-shells. Moreover, the sun is presumably encased also in harmonic gyrating electron-shells that cause the sunspot cycles. That sunspot cycles are not harmonic with the earth's orbital period is certain. Although the great sunspot cycle of about 11.136 years has affected the thickness of the sequoia rings and the varves, those effects are of less importance than those of the cycles above mentioned.

By aid of these cycles I have been able to date annual varves of the last Ice Age. For example, Antevs' varve number 4404, near Northampton, Mass., was laid down by the runoff in the spring and summer following the precipitation maximum of the 1820-year cycle which was Dec. 22, 12,855 B.C. The peak of the 1820-year cycle in 16,475 B. C. was the one nearest the peak of the 26,000-year cycle. Hence about 16,475 B. C. the 1820-year cycle produced the great terminal moraines of the last Ice Age, namely the Brandenburg Moraine in Germany, the Ronkonkoma Moraine on Long Island, N. Y., the Shelbyville Moraine in Illinois, and the Altamont Moraine in North Dakota.

The substages of the last Ice Age were each 1820 years long. There have been three Ice Ages, about 26,000 years center to center, since the 91,095 B. C. date given, the earliest of the three being the greatest. It was what geologists call the Nebraskan Glaciation during which a very thick bed of glacial till was deposited. In Nebraska this till bed is 100 ft. thick at its maximum. On top of it lies a maximum of 240 ft. of interglacial sands, gravels, etc., and then comes the Kansan till bed whose maximum thickness also is 100 ft. On top of that is another bed of interglacial deposit whose maximum is about 230 ft. where wind-blown materials do not exist. American geologists call the last Ice Age the Wisconsin Glaciation. They have occasionally erred in regarding some of its 1820-year substages as independent Ice Ages.

I have found several earthquake cycles that correspond with rainfall cycles above mentioned. I infer that there is an electronic activity in the earth's molten core corresponding with that in the atmosphere. This inference is sustained by two known cycles of variation in the rate of axial rotation of the earth, as well as by the cycles so clearly shown in many series of raised ocean beaches.

In a forthcoming paper analyses of the data used in deriving the above given cycles will be published. Another paper will give some of the outstanding historical effects of the 140 and the 1820-year cycles. A third paper will discuss the geological and topographical effects of climatic cycles.

▼

Nicholas Hill Associates Established by Former Hill Staff

Executors of the estate of the late Nicholas S. Hill, Jr., who died October 18th, 1936, have issued a statement to the effect that the offices, the good-will, the business, et al, of the former firm of Nicholas S. Hill, Jr., Consulting Engineer, have been assigned the three senior members of Mr. Hill's staff. The partners will operate as Nicholas S. Hill Associates from the same offices previously occupied by the Hill organization—112 East 19th Street, New York City.

Members of the new firm are George H. Buck, Wm. P. Seifert and Chas. F. Jost—all long connected with the old firm, which has been changed essentially in name only. The settlement promptly removes impedimenta attending operations of a professional office for the benefit of an estate.

N. Y. SECTION OF A. W. W. A. FEATURES WELCOME TO SEC'Y JORDAN

Reported by: HARRY A. FABER*
Associate Editor.

THE winter meeting of the New York State Section of A.W.W.A. was held December 29th at the Hotel New Yorker, in New York City. A congenial luncheon and brief but meaningful address by Harry E. Jordan, A.W.W.A.'s 29 day old Executive Secretary, were followed two technical papers and a round-table discussion.

It was announced that the holding of A.W.W.A.'s Annual Convention in Buffalo, June 7th to 11th rendered the customary spring meeting of the section unnecessary. The N. Y. Section will consider itself host to the entire association during the Buffalo Convention.

*Asst. Engr., The Chlorine Institute, Inc., New York, N. Y.

Officers Elected

Becoming effective March 1st, the following were chosen or carried forward as officers for 1937:

Chairman—Alan D. Drake, Director of Water, Buffalo.

Vice-Chairman—Ernest L. H. Meyer, Supt. Water, Glens Falls.

Secy.-Treas.—R. K. Blanchard, Neptune Meter Co., New York City.

Trustee—Franklin Henshaw, Mgr. Water Dept., Scarsdale.

Trustee—Wm. T. Field, Cons. Engr., Watertown.

Trustee—Chas. R. Cox, State Health Dept., Albany.

Section Director—Reeves J. Newsom, Am. Water Wks. Co., New York City.

Chas. R. Cox, recently appointed chief of the New York State Bureau of Water Supply, was unanimously elected the new Trustee. Mr. Field, retiring chairman, automatically becomes the third Trustee.

Remarks of Exec. Secretary

With warm words of welcome from the chairman, Wm. T. Field presented the new member of the New York Section, Harry E. Jordan, who was making his debut as the new Executive Secretary of the Association. Mr. Jordan did a nice job of complimenting the section on its ability to hold three meetings each year, setting thereby an example of group spirit and attendance at meetings for other sections of A.W.W.A. to consider.

Retiring Chairman Wm. T. Field, Consulting Engr. Watertown, N. Y.

Chairman Elect Alan D. Drake, Mgr. Buffalo's Water Dept.

A. W. W. A. Director Reeves J. Newsom, Vice Pres. American Water Works & Electric Co.

On the New Executive Secretary, Harry E. Jordan, Eyes and Ears Were Focused.

Touching on the present problems of the organization Mr. Jordan stressed the advisability of grooming for committee work, and other positions of responsibility, some of the younger men in A.W.W.A. who are active in the field. With regret, Mr. Jordan announced the resignation of Mr. Wolman as editor of THE JOURNAL. Heavy demands of his position as head of the National Water Resources Board, and other activities had been responsible for the resignation, but this did not mean that Mr. Wolman would lose interest or discontinue his active work in behalf of the association.

Future issues of The Journal are to be edited by the New York office staff of A.W.W.A., and several changes toward modernization are being introduced one at a time. To assure attention, a brighter colored cover (canary yellow) is being adopted; to feature timely news in the field, the Supplement to The Journal was to be resumed in a little different form. Newsy items and gossip would be on a running basis throughout the advertising section of each issue. The idea is that of increasing the potential worth of the advertising pages in The Journal.

Impressed were members with the promise that Journal changes are but an example of A.W.W.A. modernization which will be aimed to affect the entire organization.

Technical Papers

"Use of Activated Carbon in Water," by E. A. SIGWORTH, Industrial Chemical Sales Co., New York City.

For the benefit of members, this paper first summarized the growth of knowledge concerning the properties and production of the activated carbons. Mr. Sigworth agreed that credit was due manufacturers for their study—and improved carbons. However, plant operators, in their intelligent applications of the material and critical observations, deserved no little part of the credit for improved material and technic.

In evaluating carbons much could be said for the phenol adsorption test, but recently it had been shown important to determine the comparative decrease in the threshold odor number when comparing carbons.

A compilation of statistics from 102 filtration plants revealed a dosage of 16.8 lbs. per m.g. as the average

Sec'y of the Section
Rollo K. Blanchard,
Vice-Pres.
Neptune Meter Co.

Chief Round-Tabler
Franklin Henshaw,
Mgr.
Scarsdale's Water Dept.

carbon requirement. The per capita cost for this amount could be taken as 3 cents per year. Of the plants reporting the points of application, 65% were prior to sedimentation; 24% to filter influent or direct to filters, and 10% as split treatment. About 75% of all plants use dry feed application of the material, and find this best.

Citing wide variations in the efficacy of various types of carbon, one powdered carbon was shown to require 56 ppm. and another only 20 ppm. doses to produce the same removal of odor. The granular form of activated carbon, largely used in pressure filters, proves very efficient.

In the discussion following FRANKLIN HENSHAW, Manager Scarsdale Water Department, asked the method of applying carbon to reservoirs which were not followed by filtration. Mr. Sigworth cited instances where this had been done successfully, preferably when the reservoir could be withdrawn from service for two days to permit sedimentation.

GEORGE CARPENTER, Supt. Ithaca Water Dept., asked what doses of carbon are practicable when applied directly to the filters. HENRY T. HOTCHKISS, Supervising Chemist, Larchmont, stated that a dose more than one-half ounce per sq. ft. of filter area would appreciably decrease filter runs at his plant. Mr. Sigworth gave 20 to 40 pounds per m.g. as an average dose used by most plants when this method of application is used.

"The Cost of Water and Who Pays For It," by CHARLES H. CAPEN, JR., Sr. Asst. Engr., North Jersey Water Supply Comm., West Orange, N. J.

Increases in per capita consumption of water in accordance with municipal growth, according to Mr. Capen, follow definite rules, but are much influenced by such factors as metering and industrial usage. In the design of systems, various rules are accepted, but seldom well established. Mr. Capen cited those reports by the A.W.W.A. in 1930 and that of Rudd and Michaels of Detroit in 1933 as the source of much consumption and cost data.

The consumption, while averaging 132 gals. per capita for the 10,000 supplies reported, shows wide variations and an irregular trend. As cities increase in size, the greater community use often offsets the economy of increased production. Tabular and graphical data were presented with the aid of a number of slides. One curve presented enabled the development of an equation giving the gal/capita/day rate which may be considered as typical of United States supplies. Revenue per m.g. plotted against population served shows regular variation and according to Mr. Capen can be computed by a definite equation. Total consumption proves a less variable figure than does per capita use.

Considerable data was quoted for Newark, N. J., to indicate the effect of metering in the reduction of demand, with an effect on revenue almost parallel with it. The generalization that each community is a problem by itself is ordinarily true, but Mr. Capen suggested that his proposed method, by eliminating unusual factors in consumption, would serve for comparing most municipalities.

Vice Chairman and
Trustee
Ernie Meyer, Supt.
Glens Falls Water
Dept.

The Newest Trustee
Charlie R. Cox, Bureau
Chief
State Dept. of Health,
Albany.

Round-Table

Franklin Henshaw Presiding

The Round-Table was opened with a question as to the feasibility of the water utility installing service lines from main to meter. A small proportion of superintendents present indicated this to be done by their cities. Mr. Hotchkiss said this is done by Larchmont, with full approval of local plumbers. The property owner pays the same price as set by plumbers for the job. Mr. Henshaw said Scarsdale would like to follow such a plan to keep its regular number of laborers up to emergency size, and that a survey of plumbers had shown almost all would prefer this method. Ordinarily they must employ outside men for digging and would prefer to do only the inside plumbing.

Mr. Carpenter, Ithaca, asked the effect of Nuchar on residual chlorine. In reply, Mr. Sigworth indicated the point of application to be important. While carbon will adsorb a pre-chlorine dose, it may also reduce the demand placed on post chlorination. When chloramine treatment is employed, he claimed adsorption of residual to be very slight. In return, Mr. Sigworth asked the value of pre-chlorination and pre-chloramine treatment in the removal of tastes and odors.

Professor L. V. Carpenter, New York Univ., championed the use of these processes by quoting instances in which rather large doses of carbon had not been effective without super-chlorination. Stating that no generalization is safe for any method of taste and odor removal, he said that chlorination of supplies, not subject to production of byproduct tastes, *followed* by an ammonia dose sufficient only to hold the residual chlorine is finding increasing favor as an economical method.

Dr. Frank Hale, Director of Laboratories, New York City, stated in reply to a question by the chairman, that the use by Jamaica of Diesel power had resulted in a decrease of electric power costs. Prof. Carpenter quoted a similar saving at New York University. Mr. Hotchkiss cited the part-time use of a gasoline engine at Larchmont as being more economical than purchased power needed during peak load periods.

LIMESTONE CONTACT BEDS FOR CORROSION CONTROL

Simplicity, Economy and Self-Adjusting Features Attractive for Small Installations

By I. M. GLACE, C.E.*

Harrisburg, Pa.

I. M. Glace

THE borough of Dillsburg, located in the central part of Pennsylvania about 15 miles south of Harrisburg, is almost entirely residential in character. It has a population of something over 1,000.

Water is supplied to the borough by the Dillsburg Water Company, which takes its supply from a dozen springs and a drilled well situated on the wooded and uninhabitated slopes of one of the ridges of the Blue Mountains. The water is delivered by gravity to the borough through a 6-in. gravity main about 2.5 miles long. Excess flow of the springs is stored in an uncovered concrete reservoir, of about 450,000 gallons capacity, which floats on the system.

The average daily consumption is estimated to be 40,000 gallons. The low figure of roughly 40 gal. per capita per day reflects the residential character of the community, absence of sanitary sewers, and the complete meterage of services.

Quality of Supply

The water served Dillsburg is typical of that of many other similar supplies serving the considerable number of communities located in or contiguous to the Appalachian Mountains in Pennsylvania. The feature at Dillsburg, a variation from the average of these supplies, is the completely enclosed spring basins, so that the supply is entirely of underground origin with no surface water increments and no opportunity for natural aeration of the water.

The Appalachians in Pennsylvania are mainly composed of closely compacted sandstone strata, which serve as excellent filters for the water deposited on their slopes.

The following analysis of the Dillsburg water is characteristic of water of the territory—very soft and palatable, but corrosive and tuberculating:

Hardness	12 p.p.m
Alkalinity	8 p.p.m
Carbon dioxide	20 p.p.m.
pH	5.4

Where such groundwater has had opportunity to flow in stream beds, or has been otherwise partially aerated, there occurs an increase in pH and a corresponding decrease in CO_2 content. A general average for waters in the small tributaries among the mountains is about 6.7pH.

From a bacteriological standpoint the water is of such a high quality that the Coli-Aerogenes group of organisms are uniformly absent, and the average total count, at 37 degrees, is probably 2 or 3 per ml. As a consequence, where this sandstone water is properly protected against surface contamination, no treatment is required by health authorities. Such is the case at Dillsburg.

Complaints

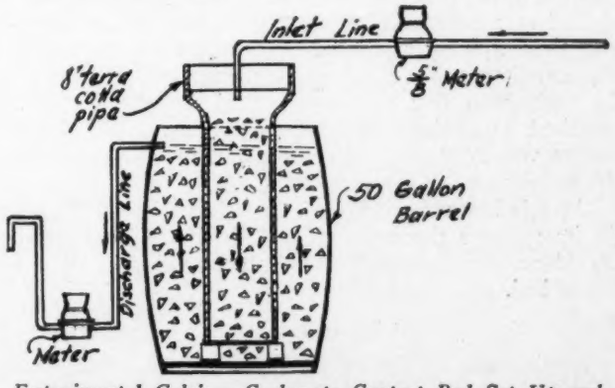
Tuberculation of the mains had resulted in a noticeable decrease in carrying capacity and pressure losses at fire hydrants. In order to cooperate with the local fire department the water company, which is exceptionally progressive for a community of this size, retained a nationally known water main cleaning company to scrape the lines. From the standpoint of recovery in main carrying capacity this operation was a success. Naturally, the cleaning exposed some fresh metal, and complaints of "red water," laundry stains, and iron tastes were received by the company. It was then that the writer and the Wayne Laboratories, with whom he is associated, were retained to recommend relief measures.

Consideration was given first to standard methods for the control of corrosion through the application of hydrated lime, other alkaline salts, to boost pH values. Such a procedure, however, requires more or less constant attention and close chemical control to be really effective. Moreover, the cost of the operations, for a small company, is excessive and the comparative remoteness of the proper point of application at Dillsburg would make it more so. A search was made, therefore, for some easier solution of the problem, one which might be less exacting in control.

Limestone—Nature's Corrective

The suggestion was made by Wayne Laboratories that beds of limestone be prepared and the spring water passed through for treatment. In the absence of concrete information and technical data on such treatment no attempt was made to put such a plan in operation because lime treatment seemed the more positive and certain method.

At about this time an article appeared in "Water Works & Sewerage," under the name of Henry Ryon,



Experimental Calcium Carbonate Contact Bed Set Up and Operated in Corrosion Control Studies at Dillsburg, Pa.

*Consulting and Supervising Engr., 22 So. 22nd St., Harrisburg, Pa.

Senior Sanitary Engineer of the New York State Department of Public Works, describing the experimental work and full plant scale results at a state institution on Long Island, where crushed marble contact filters had been installed for the correction of a well water which has practically the same characteristics as that of the spring water at Dillsburg.

Using the Ryon data, from "Waterworks and Sewerage" as a guide, an experimental unit (here sketched) was installed at Dillsburg. It was continuously operated for almost a year before determining on the plant scale design and practicability of the scheme, under winter conditions, life of the marble or limestone, and other important practical considerations, such as cloggage, difficulties and the like.

The incoming raw water and the outgoing treated water were metered as shown, using standard 5/8-inch service meters; the feed and discharge lines were of new galvanized iron pipe. The 50 gallon wooden barrel, and the terra-cotta pipes which serve as baffles for proper distribution through the tank, are filled with broken (high-calcium) limestone of about 1 inch size. The flow of water was regulated during most of the period at a rate of about 220 gals. per day, or slightly less than a pint per minute. It is interesting to note that this small amount of water was measured quite accurately (within a five per cent error) by the meters, as checked by volumetric determinations. The influent meter was operating under a head of only about one foot.

At this low rate of flow it is estimated that the water in its passage through the tank had a 2 hour contact, based on approximately 50 per cent voids in the limestone bed.

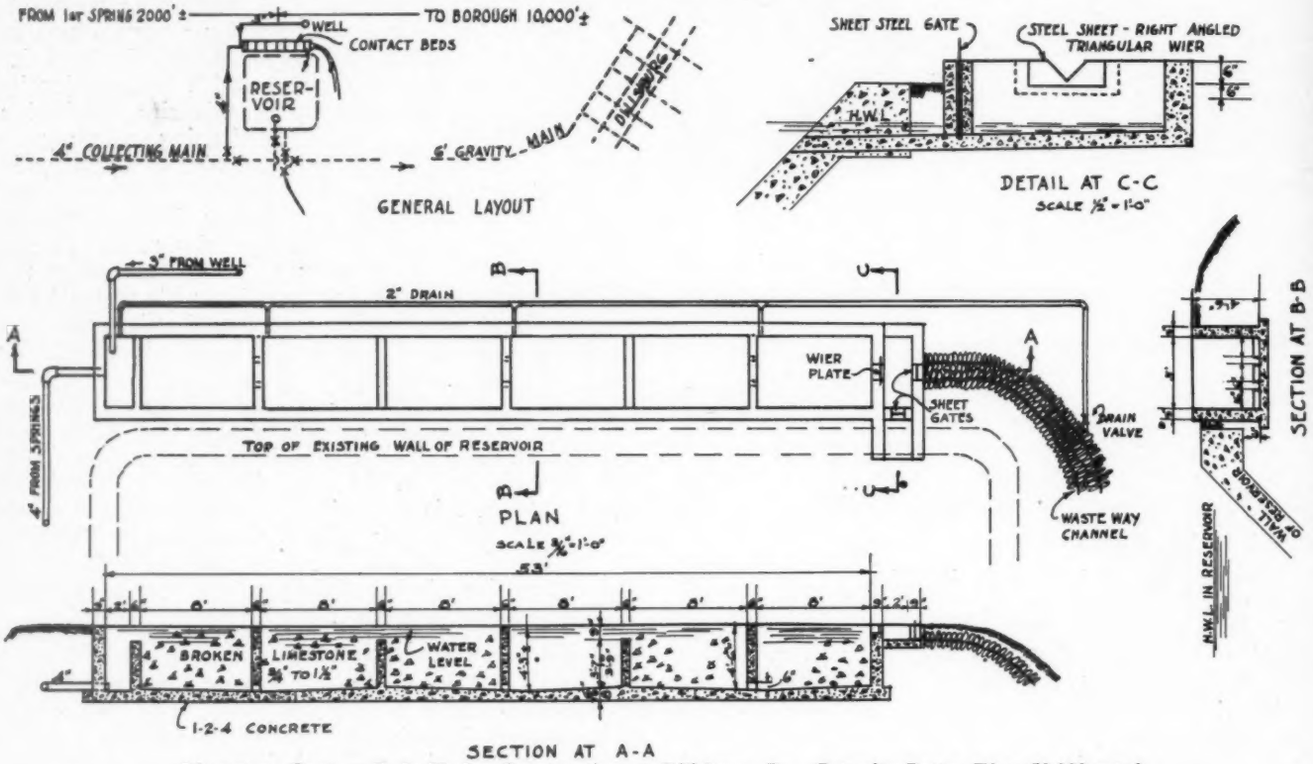
Observations and Deductions

At the end of the first six months' run, the inlet and outlet pipes and the meters were dismantled and examined. The inlet pipe was already tuberculated and badly stained. The inlet meter likewise was heavily stained, but not tuberculated. The outlet pipe, on the other hand, showed no iron discoloration, and no tuberculation or pitting, but was covered with a soft and very light gray film. The outlet meter was not affected one way or the other.

The limestone at the top of the down-flow (inlet) compartment, was also excessively stained but, the stone surfaces at the outlet side were as clean apparently as on the day they were placed.

During this six-months period the rate of flow was uniform, it being controlled by means of a drilled coin union placed in the inlet line. Later a larger orifice was inserted and the rate tripled, with an immediate decrease in the efficiency of the treatment being noted.

Based on a number of determinations made in the field and in the laboratory (with results averaged), the experimental unit produced a very consistent effluent as follows:



Limestone Contact Beds Under Construction at Dillsburg, Pa. Capacity Better Than 50,000 *g.p.d.*

	Raw	Treated
Hardness	12 p.p.m.	28
Alkalinity	8 p.p.m.	24
Carbon dioxide	20	2
pH	5.4	7.4

The practical benefits of a non-corrosive water have recently been well demonstrated by the New England Water Works Association, in its report on Pipe Line Friction Coefficients, which emphasizes the interrelationship between calcium carbonate, alkalinity, and CO_2 content, and the value of pH of the supply as an index of rate of capacity loss. The figures given above seem to be in agreement with the findings of the committee.

As a result of this experimental work, a full-scale plant (see sketch) has been designed, using the same principles of treatment, and is now being installed at Dillsburg.

The active officers of the Dillsburg Water Company are W. P. Deardorff, President; C. M. Thumma, Treasurer, and G. C. Fissel, Superintendent.

Additional Observations

Further evidence of the efficacy of this type of treatment, for control of corrosion, has been secured in another and much larger community, located in the same range of mountains. Here the water works is operated by a holding company, with a local superintendent in charge. The supply is essentially the same as that at Dillsburg, except that the water discharged from several springs flows over the surface of the ground before it is impounded in an uncovered and unlined reservoir, holding two or three days' average consumption. The supply is clean, but chlorination is provided to protect against contamination.

The distance between the spring basins and the reservoir is comparatively short so that little opportunity is afforded for aeration or change in water quality. The pH of the water varies, but when there is no surface runoff, the pH and other characteristics of this supply are approximately the same as those at Dillsburg.

The mains of this company were cleaned some 8 or 10 years ago but, unfortunately, no record is available to reveal conditions subsequent to such cleaning. At the present time complaints of "red water" are frequent occurrences. This condition existed in the home of the local superintendent who, on his own initiative, removed the iron service lines in his home and installed copper service pipes throughout, as well as a copper hot water tank. This was shortly before the experiments were begun at Dillsburg.

In less than a month after the copper pipes were installed, the iron stains formerly present on the plumbing fixtures disappeared, and the typical green stains of copper became noticeable. To these the writer's attention was directed at about the time that the first definite data had been secured at Dillsburg.

As a further experiment, therefore, a 50 gallon galvanized iron hot water tank was secured, filled with ½-inch broken limestone, and installed on the service line into the superintendent's home.

An immediate improvement followed. The copper stains disappeared from the fixtures and, after six months' operation, have not again re-appeared. A number of tests have been made in the field on the water entering the house at the meter, and on taps inside the home. Because of the great irregularity of flow of water in this as in other private homes, the pH and other characteristics of the treated water have not been so uniform as were those of the Dillsburg unit, which was operated at a constant rate of flow. However, at no time did the pH of the limestone-possivated tap water fall below 7.0 and has been usually higher. No attempt has been made as yet to test the first water drawn in the morning, when treatment should be at its maximum.

Household and Institutional Possibilities

Certainly where decidedly aggressive water occurs, the proper method would be to correct the entire town supply. If, however, the municipality or company is unable for any reason to provide control, rapid deterioration of house lines can be prevented or markedly suppressed by this individual treatment. Inequalities of flow in the home could be smoothed out by providing contact tanks of large capacity so that, even during periods of heavy draft, the retention in the contact tank would be sufficient to bring the pH of the water to or near the maximum obtainable by the process.

Tuberculation of pipes to such an extent as to interfere with the flow of water, or to cause destruction of the metal, is a slow process with water of average analysis, usually a matter of years. The effect of corrective measures, similarly, cannot be determined without the lapse of considerable time and many observations. It is recognized that additional tests and further demonstrations are necessary before final conclusions are justified on this simplified type of treatment. The results to date, however, have definitely surpassed expectations and the method is attractive even if some supplementary chemical treatment proves advisable at a later date.

▼

George C. Bunker Appointed Sanitation Adviser to Venezuelan Government

George C. Bunker, Consulting Engineer, American Canal Zone, has been recently appointed official adviser to the Department of Public Works of the National Government of Venezuela with headquarters in Caracas. Mr. Bunker, a pioneering sanitary engineer in Central and South America, and recipient of medals from municipalities he has done work for, will serve the Venezuelan Government as consultant and adviser in connection with water supply and purification developments. His address is the American Consulate, Caracas, Venezuela.

▼

Meetings Scheduled:

Jan. 20-23—NEW YORK CITY, N. Y. (Society Headquarters).
American Soc. Civil Engrs. Sec'y Geo. T. Seabury, 33 W. 39th St., New York City.

Jan. 21—BOSTON, MASS. (Hotel Statler).
New England Water Works Association. Boston, Mass. Sec'y, Frank J. Gifford, 613 Statler Bldg., Boston, Mass. (Also meeting Feb. 18 at Hotel Statler.)

Jan. 22-23—NEW YORK CITY, N. Y. (Hotel McAlpin).
New York State Sewage Works Association. Sec'y A. S. Bedell, State Department of Health, Albany, New York. (On January 21st the Sanitary Engineering Division of A. S. C. E. holds its meeting, followed by the Annual Joint Dinner with N. Y. S. S. W. A. Attention is called to this new scheduling of the dinner and meeting the day following—Friday—and joint inspection trip on Saturday.)

Feb. 10—PORTLAND, ME. (Douglas St. Works).
Maine Water Utilities Association. Sec'y, Earle A. Tarr, Winthrop, Me. Douglas St. Works, Portland Water District.

Feb. 15-20—COLLEGE STATION, TEXAS. (State College).
Texas Water Works Short School. Sec'y, V. M. Ehlers, Chief Engr., State Dept. of Health, Austin, Texas.

Mar. 11-12—TRENTON, N. J. (Stacy-Trent Hotel).
New Jersey Sewage Works Association. Sec'y, John R. Downes, Bound Brook, N. J. (22nd Annual Meeting.)

Mar. 25-26—(Location to be selected.)
Four States Section A. W. W. A. Sec'y, C. A. Hechmer, Engr., Washington Suburban Sanitary District, Hyattsville, Md.

Mar. 30-April 1—(Location to be selected.)
Florida Section A. W. W. A. Sec'y, J. R. Hoy, W. & T. Co., 404 Hildebrandt Bldg., Jacksonville, Fla.

April 6-18—(Location to be selected.)
Southeastern Section A. W. W. A. Sec'y, W. H. Weir, State Board of Health, 135 State Capitol Bldg., Atlanta, Ga.

Apr. 12-14—CHATTANOOGA, TENN. (Hotel Patten).
Kentucky-Tenn. Section, A. W. W. A. Executive Secretary, H. D. Schmidt, State Dept. Health, Nashville, Tenn.

April 14-16—MONTREAL, CANADA (Windsor Hotel).
Canadian Section, A. W. W. A. Sec'y-Treas., A. E. Berry, Chf. Engr., Ontario Department of Health, Parliament Buildings, Toronto, Ont.

April 19-12—(Location to be selected.)
Montana Section, A. W. W. A. Sec'y, H. B. Foote, Chief Engr., State Board of Health, Helena, Mont.

June 7-11—BUFFALO, N. Y. (Hotel Statler).
American Water Works Association (Annual Convention). Executive-Secretary, Harry E. Jordan, 29 West 39th St., New York City.

EDITORIAL

Engineers and Chemists Who Pay Their Way

IN THIS issue appears an article by Walter A. Sperry, a former water works chemist who became superintendent and later city manager of an important mid-west city. Now, as superintendent of Aurora's sewerage system, what Mr. Sperry has accomplished is worthy of note. As an operating engineer-chemist he turns creek water into sewers to speed sluggish flows and preclude degradation through septic action. As a manager he operates the Aurora plant in a manner to win approbation of his commission and confidence of the visiting public and jury to the extent that with "character witnesses," more than analytical data and experts, he comfortably wins nuisance damage suits.

Mr. Sperry's current article tells of only the most recent development at Aurora, involving an ingenious adaptation of gas-engines to direct-drive but variable-speed automatic continuous pumping of crude sewage. Remarkable have been the resulting savings for power, at the rate of $5,000 or better per year from the initial investment of $12,700 for engines and equipment. Illustrative of the worth of an engineer-manager, Mr. Sperry's article reveals how $7,500 was cut from the initial cost in the selection of storage and handling equipment for the digester gas. To these recent savings could be added the claim of $9,000 saved, on the average each year, for a period of years. The latter has been the result of the method of operating the Aurora plant on a schedule designed to make full use of the varying dilution available in the receiving stream. All of this is engineering in the highest meaning of the word.

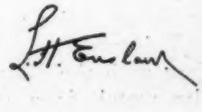
This is not the first instance of the use of this page for the purpose of directing attention to the value of operating engineers and chemists who pay their way. In industry chemists and engineers have a very definite incentive to reduce operating and production costs and to improve the quality of products. Their anticipated rewards come in very tangible forms—promotions, salary increases, bonuses or profit sharing. These may be, and frequently are, secondary considerations in the minds of the type of individuals who always "get ahead" in the industrial and commercial field; but, none the less, financial reward constitutes an impelling motive in the human makeup. Another reason for greater incentive to create and effect economies in private enterprise is the fact that manager, chemist or engineer in industry realizes that he is expected to produce sufficiently to at least justify the cost of his services to producers operating in this age of keen competition where "the survival of the fittest" (and the shrewdest) seems to be the modern Golden Rule.

Contrasted with municipal operations, the manager, engineer or chemist in governmental employ is not given the same incentive, nor is he faced with the necessity, to show that he is at least paying his way. Too frequently his chief concern is with his standing politically—the term being applied in both the broad and the narrow sense. In short, his first consideration is that of holding his job. That is to say, self-security is the paramount interest rather than an incentive to "do things" which may bring suspicion from a superior that the "doer" is overly ambitious, and is a threat at his job which must be suppressed, discouraged, or removed. To the younger man with initiative and energy this uninviting picture forces most of them into private enterprise where advancement is won wholly on ability and not length of service. It is in this direction that the protective Civil Service System is unduly protective and shows a decided weakness in blocking advancement and destruction of incentive in those who wish to go forward on proven ability.

Now, all of this "around the barn" analysis to get to the horse can be summed up in a sentence by merely saying that the professional man and managers who "do things" in governmental employ have one primary motive—that of service to society and credit to the profession. Ample reward to this worthy and conscientious individual is that high personal satisfaction which comes from worthwhile accomplishment in any direction. Unfortunately for his dependents, his gain too frequently stops with this.

In the water works and sewerage fields considering actual duties the scale of remuneration of responsible positions is unfortunately low, this fact being frequently remarked upon by laymen to this commentator. What is the reason for this condition? Why should it continue? Certain it is that the supplying of safe and palatable water to a community is a class of service which can not be had for so little, or a product comparable in value to pure water can not be bought as cheaply in even the highly competitive commercial field. Is it a lack of incentive on the part of operators? Or is it not the fact that the type of individual who remains to become the most successful in municipal utility operation is the man who gets out of this service the joy of it; that is to say, the conscientious man who values self-satisfaction for a service rendered above remuneration. Principally, this commentator believes that the last is the true answer to the situation in the majority of insances.

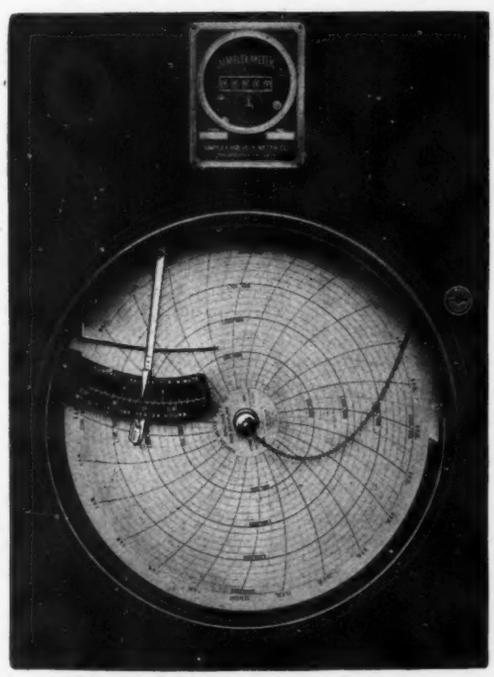
Failure of adequate appraisal (both within and without) of value for services performed is a definite weakness in the water supply and sewerage disposal fields. It is time that something be done to correct this situation. One brief sit-down (or walk-out) strike in the local water works plant would prove a certain corrective, but unionization of water works operation and the seriousness of stoppage of a water supply are too foreign to the conscientious minds of water works men to justify further comment. The only remaining course seems to be the education of the public and movements judiciously started in strong community organizations for more adequate recognition of those behind the indispensable water service. Last, but not least, the nearest approach to unionization available—that is, the introduction in every state of Operatives' Licensing Acts with a maximum of uniformity. Is it not practicable that a pattern in the form of "A Model Operator Licensing Act" be drawn and sponsored by the four leading water works and public health organizations—the American Water Works Association, the New England Water Works Asociation; the American Public Health Association, the Conference of State Sanitary Engineers?



Ward's Island

Only one of the many large sewage disposal plants for which Builders metering equipment has been selected in recent years.

Builders Iron Foundry
Providence, R. I.



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EQUIPMENT NEWS

Wireless Pipe Locator

A truly wireless pipe locator has just been announced by Dr. Gerhart R. Fisher, Director of Fisher Research Laboratories and Sales Company of New York and San Francisco.

This new instrument, known as the Fisher "M-Scope," consists essentially (as pictured) of two battery operated radio units—a transmitter and receiver. It can be most efficiently used by two men, but one man can operate it; no wire connections being needed to locate a lost valve or trace a buried pipe line. The system of locating for position and direction (by tone of radio signal), simultaneously reveals the depth of the pipe below ground surface. Tracing a line or finding service connections and valves is no more complicated than placement of the transmitter

The M-Scope.

on the ground above the located pipe and, with the receiver, "follow-away" along the path of maximum signal intensity which lies directly above the pipe. Pipes under 50 feet of cover can be located.

This interesting wireless "M-Scope" is constructed of standard radio parts, which are readily replaced or repaired. The transmitter and receiver weigh about 8 lbs. each and the complete outfit (in carrying case) weighs 22 pounds. Its use is fully described and illustrated in a special, easy to read, bulletin—"The M-Scope." Address, Fisher Research Laboratories Sales Company, 45 Rockefeller Plaza, New York City; or in the Board of Trade Building, San Francisco, Calif.

▼

Improved Single Operator Welder

Lincoln Electric Company of Cleveland, Ohio, are offering their new single operator type "Shield Arc SAE" Electric Welder, which incorporates several desirable features. The outstanding feature is the continuous dual arc control, which is new. Its use makes possible the adjustment of arc heat and arc penetration in continuous sequence of small increments. This feature gives exact control of a wide range of amperage (current flow) at low or high but *constant voltages,* as may be most desirable for the work at hand—something heretofore difficultly obtained.

Lincoln Welder.

All of the best features of the time proven predecessor—"Shield Arc" model Lincoln Welders—have been retained in the 1937 models, with added improvements in design of body and chassis. Capacities are 300, 400 and 600 amps. for motor drive; 200, 300, 400 amps. for gas-engine powered units.

For descriptive booklet on "Shield Arc S. A. E. Welders" address Lincoln Electric Company, Cleveland, Ohio.

▼

Vertical Turbine Dewatering Pump

Vertical turbine pumps designed and built specially for dewatering cofferdams, mines, quarries, etc., upwards in capacity including 10,000 gallons per minute are now offered by Worthington Pump and Machinery Corporation, Harrison, N. J.

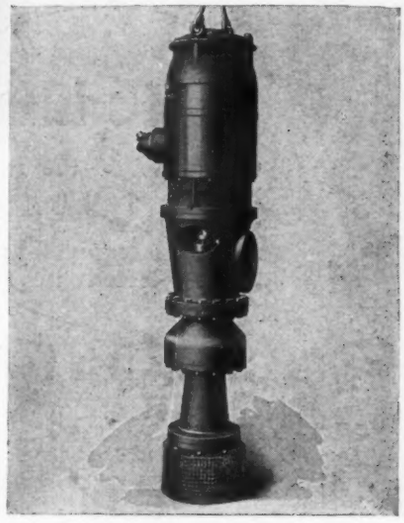
These pumps are exceptionally simple in design, are compact, and may be used either as portable sinker pumps to be lowered as the water level recedes, or may be fitted with suitable pipe lengths for fixed installations.

The following features are listed by the manufacturers:

A weatherproof motor at the top, fitted with a vertical hollow shaft, is grease lubricated to prevent leakage in transit or when the pump is not in a vertical position. The stuffing box, near the motor, is easily accessible. The stainless steel shaft serves the dual purpose of resisting corrosion and assuring ample strength. The inlet vane is grease-packed, requiring no attention by operators. Intermediate bushings are readily renewable and are made of hard bronze or, where required, of special material, depending upon the nature of the water. Impellers are of hard bronze, carefully balanced. Impeller wearing rings are renewable, and are also of bronze. Locks prevent the impeller from working loose, yet permit easy removal. The bowls containing the discharge vanes and the low head and discharge connections are of rigid cast-iron construction. At the bottom is a galvanized basket strainer which protects the pump.

These pumps are rated for total dynamic heads of 20, 30, 40, 50, and 60 feet, the motor sizes varying from 5 to 250 horsepower, with speeds ranging from 870 to 1750 revolutions per minute.

Bulletin W-450-B25, obtainable on request, shows a vertical cross-sectional view of the pump, an installation, and gives a complete table of ratings. Address Worthington Pump and Machinery Corp., Harrison, N. J.



New Worthington Vertical Turbine Dewatering Pump

▼

Flynn Becomes Chief Engineer of Oliver United Filters

To us comes news of the recent appointment of E. D. Flynn as Chief Engineer of Oliver United Filters, Inc., with headquarters in Oakland, Calif. He will, however, direct engineering for all Oliver-United factories.

E. D. Flynn

Mr. Flynn is a native of Michigan, and a graduate of the University of California. Since 1917 he has been continuously associated with the Oliver Company and his experience in the filtration field comprises engineering, design, field service, sales and executive direction.

Immediately prior to his transfer to Oakland as Chief Engineer he had been in charge of the Central Sales Division with headquarters in Chicago. Ed. Flynn's many friends will wish to join with us in congratulating both him and his company on this promotion.

LFC

Another Super-de Lavaud

Installation by "Lynchburg"

Invariably—the Lynchburg Foundry trade mark rates high with Engineers and Contractors who have built enviable reputations . . . Excellent Foundry Technique, Prompt Service, and Equipment to produce the UNUSUAL and DIFFICULT are in no small measure responsible for this high rating . . . Regardless of whether your requirements are large or small—Write, Wire or Phone "Lynchburg" for quick estimates.

Bell and Spigot Pipe and Fittings. From 4" to 54".
Cast Iron Flanged Pipe. From 3" to 84".
Cast Iron Flanged Fittings and Flanges. From 1" to 84".
Super-de Lavaud Centrifugal Cast Iron Pipe.

Special Iron Castings for the Chemical Industry

LYNCHBURG FOUNDRY COMPANY

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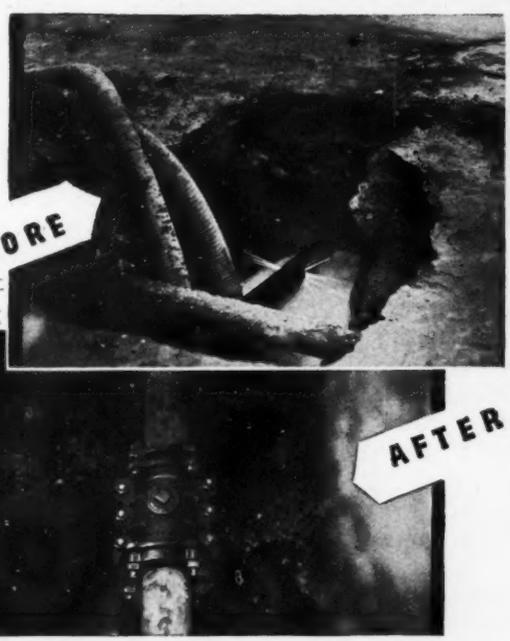


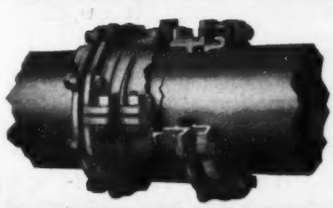
When Pipe-Breaks Occur . . . Here's How to Restore Service *Quickly...Easily...Permanently!*

NOBODY enjoys a service *interruption* —least of all the waterworks superintendent. That's why the Dresser method of repair makes such a big hit with every waterworks department that has tried it. Difficult repair jobs are made **EASY**! Service is restored in a few minutes' time—instead of hours!

When there's a *break, split,* or *hole* in the straight run of the pipe, simply do this: (a) Place the bottom half of a Dresser Sleeve beneath; (b) the top half above; (c) insert the bolts; (d) tighten with a wrench; (e) screw in the vent plug. *The repair is permanent.*

This method is nearly 50 years old in practice. The Dresser Split Sleeve is a completely engineered product—double-tested before shipment at the factory. Thousands have been installed by waterworks departments everywhere. *Send for folder No. 57 and ask for prices on specific pipe sizes in your system.*

ABOVE—Style 57 Sleeves can be joined in multiple installations of two or more, to cover breaks longer than 8".



ABOVE—Dresser Style 57 Split Sleeve used for repairing breaks in the straight run of the pipe.

LEFT—Cutaway view of a Style 57 Split Sleeve, showing working principle. Once sealed with a Dresser Split Sleeve, the break is sealed permanently.

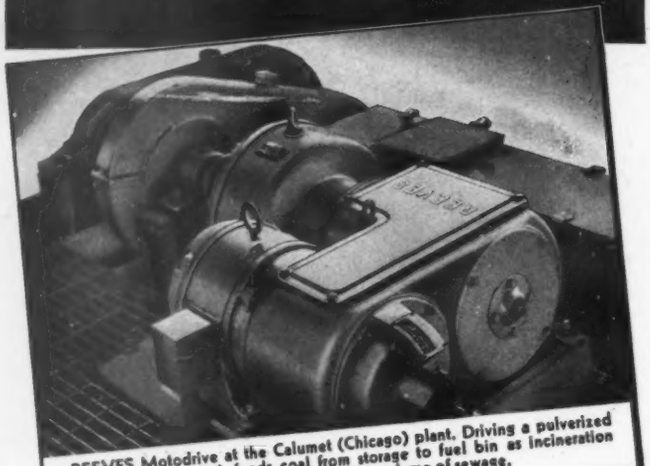
BELOW—Another style of sleeve—Style 26—encloses split or broken bells.

S. R. DRESSER MANUFACTURING CO.
BRADFORD • PENNSYLVANIA

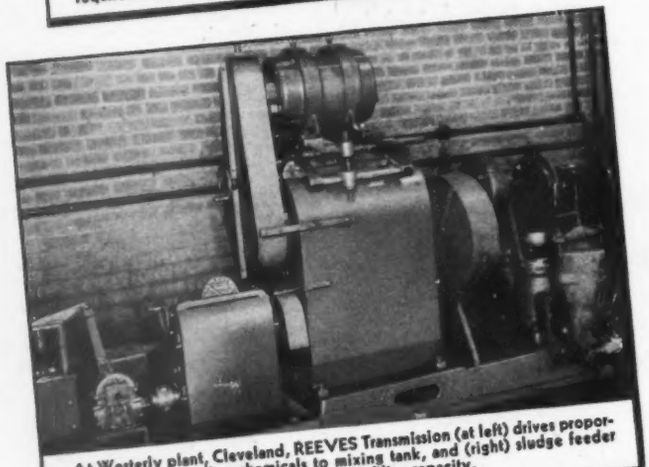
In Canada: Dresser Mfg. Company, Limited
60 Front Street, West, Toronto, Ontario

KEEP A DRESSER SLEEVE ON HAND FOR QUICK REPAIRS

SPEED CONTROL
At Work in Sewage Plants



REEVES Motodrive at the Calumet (Chicago) plant. Driving a pulverized coal conveyor which feeds coal from storage to fuel bin as incineration requirements vary in handling a fluctuating volume of sewage.



At Westerly plant, Cleveland, REEVES Transmission (at left) drives proportioning pump feeding chemicals to mixing tank, and (right) sludge feeder pump, varying speed in accordance with filter capacity.

REEVES Speed Control units provide infinitely adjustable speeds, between pre-determined limits, on any machines they regulate. Speed changes are effected smoothly—without steps or jumps—while machines are operating. The correct speed is instantly available to compensate accurately for the many variables encountered in sewage disposal processes. Many different methods of control, including sensitive automatic control to maintain perfect synchronization of speeds between processes. Send for FREE copy of 112-page Speed Control Handbook S-37. REEVES PULLEY COMPANY, Columbus, Indiana.

★ MODERN
★ ACCURATE
★ TIME-TESTED

REEVES
SPEED CONTROL

CATALOGS AND LITERATURE RECEIVED:

[*Any of the publications reviewed in this section can be secured from or through Water Works and Sewerage, if such be desirable.*]

"A Handbook: Iron Salts and Chlorine in Sewage"—From Wallace and Tiernan Co. have been received three very enlightening and useful booklets. "Technical Publication No. 177" deals with application of chlorine in a variety of sewage problems and the adaptation of iron salts in chemical precipitation of sewages. Schematic drawings indicate purpose of use and points of chlorine application in six types of sewage treatment plants. In chemical precipitation the various compounds of iron are discussed. The method of production and economies of chlorinated-copperas as compared to iron chloride from iron scrap and chlorine are set forth and typical arrangements are sketched. At the end of the book are conversion tables, charts and a glossary of terms used in sewerage practice.

Technical Reprint 465—"Iron Salts in Sewage Treatment" constitutes a reprinting of articles by Enslow, Veatch, Riker and Hendon, taken from the literature on chemical precipitation of sewage and odor control. Technical Pub. No. 148 pictures typical sewerage installations of W. & T. chlorinators. For any one or all three publications (177-465-148) address, Wallace and Tiernan Company, Newark, N. J.

"Deep-Well Turbine Pumps"—From Byron Jackson Company—(for 35 years builders of deep-well turbines)—comes a splendidly put together bulletin of 40 pages. It discusses and effectively illustrates many technical phases of deep-well pumping and pump specifications, and selection of pumping equipment (water or oil lubricated) for specific conditions at hand. Five types of well discharge heads are illustrated and discussed. A clever chart shows graphically the distribution of power balance (losses) in a deep-well turbine. Other charts disclose friction losses and the closing 6 pages are devoted to tables and charts of "Engineering Information." Epecially interesting are the methods of computing power requirements and costs of pumping. For bulletin No. 366, address Byron-Jackson Company, Berkeley, Calif.

"From Main to Meter"—Is the slogan on a recent bulletin, from the 76 year old rejuvenated Union Water Meter Company of Worcester, Mass. Illustrated, is the variety of service cocks, fittings, stops, couplings, service piping, etc., produced by the meter company. Along with this comes a rather complete catalog of the recently reorganized and revitalized Union Meter Company which illustrates and lists King Disc Meters, Nilo Velocity Meters and Compound Meters, Union Compounding Valve (which converts ordinary meters to the compound type), Pressure Regulators and Altitude Valves. A third catalog (No. 67) is devoted to the long established cone type Union Chronometer Valves which have been used for dependable setting of air, water, steam or gas flow during the past 75 years. For "Union Meters," and Catalogs 56 and 57 address Union Water Meter Company, Worcester, Mass.—an old company with new blood.

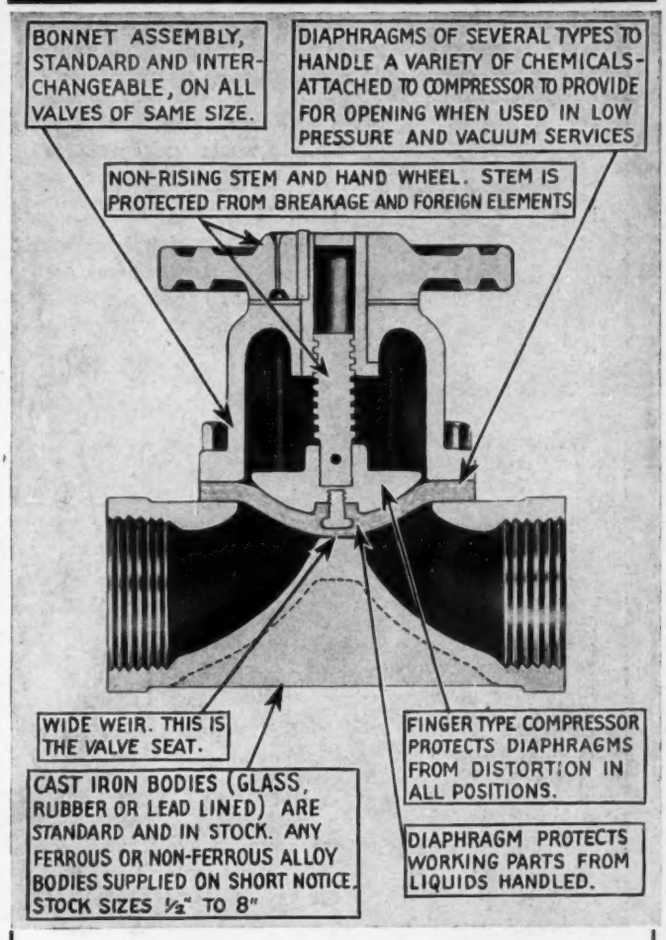
"Asphaltic Jointing Compounds"—In a very useful bulletin of this title the Clay Products Association (Chicago) has compiled a listing of 13 proven sewer-pipe jointing compounds (by trade names) with the names and addresses of the manufacturers of each. For assistance in drafting specifications, the engineer will find useful information concerning the essential qualities of jointing materials, also practical tests for application to compounds. Also, is outlined approved practices in making joints. Tables show A.S.T.M. standard dimensions of vitrified sewer pipes, quantities of jute and compound required per joint for various sizes. The latter list covers all 13 of the approved compounds, each by trade-name. This worthwhile bulletin is in reality a "Hand-book on Asphaltic Jointing of Sewer Pipes." Address Clay Products Association (J. D. Cook, Secretary), 11 W. Washington St., Chicago, Ill.

"Rotameters"—Are effectively described by Schutte and Koerting of Philadelphia, in an attractively illustrated bulletin just off the press. Much has been heard lately concerning the "Rotameter" for measuring, and recording, or controlling, flows of air, gases, steam, liquids. In the industrial field the principle and equipment has already been established for some time. The "Rotameter," new to the water and sewage field, possesses interesting possibilities. The "Rotameter" proper consists essentially of a vertical heavy walled glass tube having a *tapered* (large end up) bore, graduated with etched markings during calibration. Inside of the tube is a top-shaped float of the proper material for the gas or liquid measured. As the gas or liquid rises through the tube the float is raised, due to the velocity head of the fluid passing it. Slots in the float head causes it to rotate at speeds varying with flow rates. Thus the float remains centered and level at all flows and allows a steady and exact reading of the etched flow-scale. The hydraulic principle, description and applications of the Rotameter to exact control of flows and meterings are intriguing. Water works and sewerage engineers unfamiliar with the "Rotameter" will find much of interest in Bulletins 18-R, 18-S, 18-T. Address Schutte & Koerting, 12th and Thompson St., Philadelphia, Pa.

"Hi-Test Threaded C.I. Pipes"—A new bulletin decribes and illustrates advantages of small diameter C. I. Pipes, known as Walworth Hi-Test Pipe, available in 9 types of ends in lengths 5, 10, 15 and 20 feet. Featured are the three types of threaded joint, uniform wall thickness; available in sizes of 1¼ to 6 inches, with tapping collars on the smaller sizes. Flexibility and corrosion resistance are stressed as is the ease of make-up lines. For Catalog "A" address Walworth Company, 60 East 42nd St., New York City.

"Ventilating Propeller Fans and Blowers"—In a recent 64 page catalog is presented the complete and well known line of I L G Ventilating Fans and Blowers, manufactured since 1906 by the I L G Electric Ventilating Company of Chicago. Correct methods of calculating ventilating fan capacity requirements and selection of locations are set forth, many modernized types and styles of fans (portable and fixed) for a variety of purposes being shown and described. The last half of the catalog is devoted to features of and specifications covering I L G Universal Blowers, especially designed for noiseless operation. Also described are I L G Pressure Type Blowers, Air Blowing Heaters and Air Conditioners and Coolers. For a copy of Catalog FB-45, address I L G Electric Ventilating Company, 2850 N. Crawford Ave., Chicago, Ill.

The Valve that is creating so much interest in SEWERAGE *and* WATER TREATMENT FIELDS


BONNET ASSEMBLY, STANDARD AND INTERCHANGEABLE, ON ALL VALVES OF SAME SIZE.
DIAPHRAGMS OF SEVERAL TYPES TO HANDLE A VARIETY OF CHEMICALS-ATTACHED TO COMPRESSOR TO PROVIDE FOR OPENING WHEN USED IN LOW PRESSURE AND VACUUM SERVICES
NON-RISING STEM AND HAND WHEEL. STEM IS PROTECTED FROM BREAKAGE AND FOREIGN ELEMENTS
WIDE WEIR. THIS IS THE VALVE SEAT.
CAST IRON BODIES (GLASS, RUBBER OR LEAD LINED) ARE STANDARD AND IN STOCK. ANY FERROUS OR NON-FERROUS ALLOY BODIES SUPPLIED ON SHORT NOTICE. STOCK SIZES ½" TO 8"
FINGER TYPE COMPRESSOR PROTECTS DIAPHRAGMS FROM DISTORTION IN ALL POSITIONS.
DIAPHRAGM PROTECTS WORKING PARTS FROM LIQUIDS HANDLED.

HILLS-McCanna Saunders' Patent Valves are creating unusual interest in the Sewerage and Water Treatment Field, because they do not clog, leak, break or corrode, and have low first cost and maintenance. These valves are used for handling Ferric Chloride, Alum, Chlorine and Carbon Solutions; also for Sludge, Air, Water, etc.

These Valves are produced in sizes from ½ to 12 inches. Bodies made from a variety of alloys; also cast iron, lined with lead, glass or rubber.

Send for copy of our New Valve Bulletin.

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SAUNDERS PATENT
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Smooth, Dependable Control

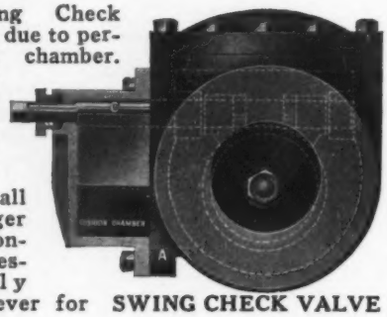
ALTITUDE VALVE

ALTITUDE VALVE assures perfect water-level control in tanks, standpipes and reservoirs.

Always function without any water surge or shock due to efficient air and water cushioning.

Furnished with automatic, electric and manual control, and for single or double-acting service.

Cushioned Swing Check valve is non-slam due to perfect cushioning chamber. Minimum friction loss through valve and soon pays in power cost savings.



Furnished in all sizes 4" and larger for all service conditions and pressures. Easily equipped with lever for manual control.

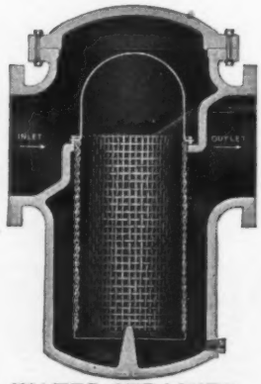
SWING CHECK VALVE

FLOAT VALVE

Float Control Valve for high or low pressure service which can function on any desired water level variation desired. No water hammer or shock due to air and water cushioning.

Furnished in angle or globe patterns ¼" to 24" sizes in bronze, iron body or steel. No metal contacts assure lifetime service.

Clean water constantly assured by the efficient and economical strainer, supplied with any mesh basket of any material to meet the service demands. Easily and quickly cleaned. Designed for maximum capacities with minimum friction loss. Sizes 3" to 24".

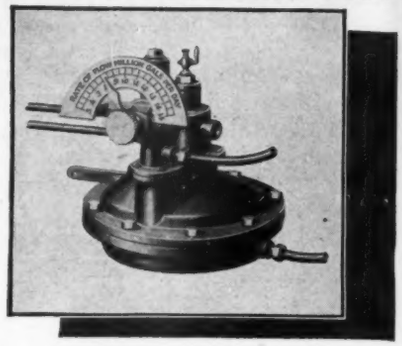


WATER STRAINER

GOLDEN-ANDERSON VALVE SPEC. CO.
1329 FULTON BLDG.
PITTSBURGH PENNA.

Type CD Rate of Flow Controller

The Actuator



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- Lime-Soda Water Softeners
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- Oil Removal Filters
- Proportioning Equipment
- Pressure Filters
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- Rate of Flow Controllers and Gauges
- Sampling Tubes
- Solenoid Operated 4-Way Valves
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- Zeolite Water Softeners

MANY advantages result from the sensible operating principle of the Infilco CD Controller — the maintenance of a **constant differential** across the actuator diaphragm at equilibrium position, **no matter at what rate the controller is set.**

All the actual controlling elements are placed **inside** the actuator casing. The only duty of the diaphragm is to move the small CD balance weight and the light control pilot. Stuffing box and pivot friction is eliminated. The measuring efficiency of the measuring element is not impaired. The Controller is exceptionally accurate throughout its operating range.

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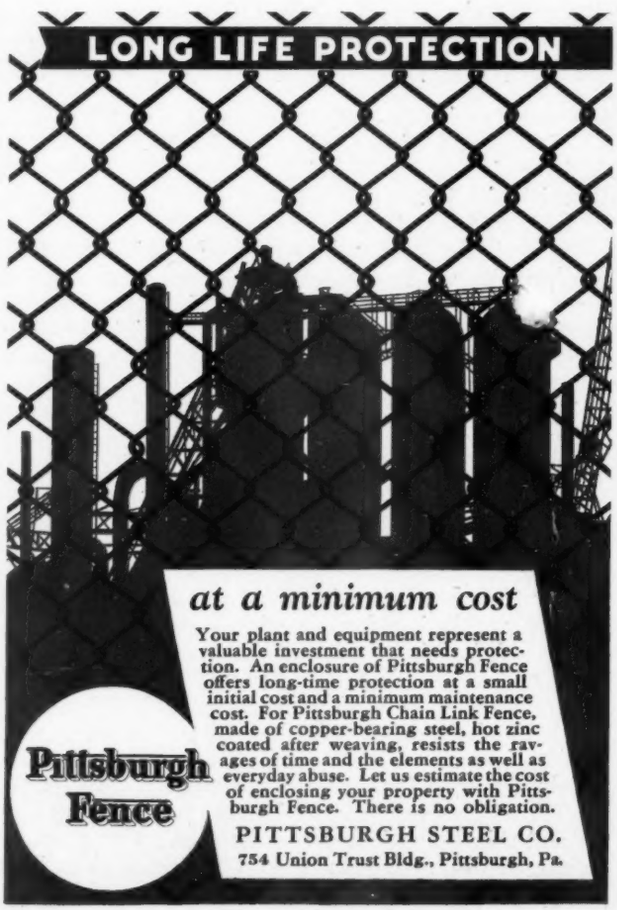

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This man is pouring

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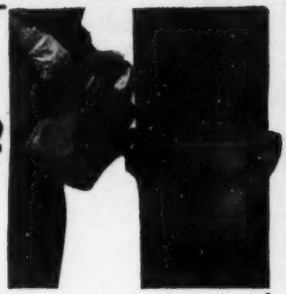

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FOR BELL AND SPIGOT SEWER PIPE

It's a wise man who uses SERVICISED Pipe Jointing Compound for SERVICISED produces a joint that is tight, flexible, economical, absolutely waterproof, impervious to weather or soil conditions and prevents root growth or other infiltration problems.

Simple to heat and apply, SERVICISED Compound can be applied by odinary laborers. Further information on request.

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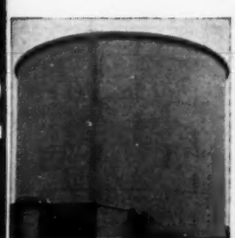
GENERAL STEEL PLATE CONSTRUCTION

GRAVER TANKS

WATER CONDITIONING EQUIPMENT



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People want soft water. A municipal water-softening plant is a project that receives instant popular acclaim.

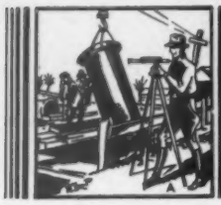
Soft water makes every housewife's work easier—saves soap—makes scrubbing, cleaning, laundering and dish-washing more effective and less laborious—reduces wear and tear suffered by garments and linens in washing. Velvety soft water is delightful for bathing—safeguards skin and complexion from hard water hazards—is a wonderful improvement over hard water for shaving and shampooing—makes foamy, fluffy suds with less soap—leaves no "ring" around bath-tub or basin—and prevents costly stoppage of plumbing by accumulations of scale and lime-soap curd which hard water causes. Soft water is better for cooking, better for cleaning, better for the health and comfort of every member of the family.

A Permutit Zeolite Municipal Water Softening Plant gives every home—every citizen in your town—these prized and priceless advantages enjoyed by other communities. Such a plant is moderate in cost and inexpensive to operate and maintain. Operates on the zeolite "base exchange" principle—proven dependable and economical in many installations.

Permutit engineers will plan and install the equipment, organize, train and supervise an operating force and furnish all needful service. The Permutit organization—largest in the world specializing in water conditioning, is prepared to handle all problems of water softening, purification and removal of iron, odor, taste and all other undesired elements from your water supply. It is amply financed and fully responsible. Your inquiry is cordially invited and will be promptly and competently handled without obligation. Write THE PERMUTIT COMPANY, Dept. G1, 330 West 42nd St., New York City.

Permutit

Water Conditioning



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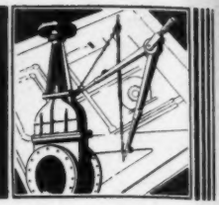

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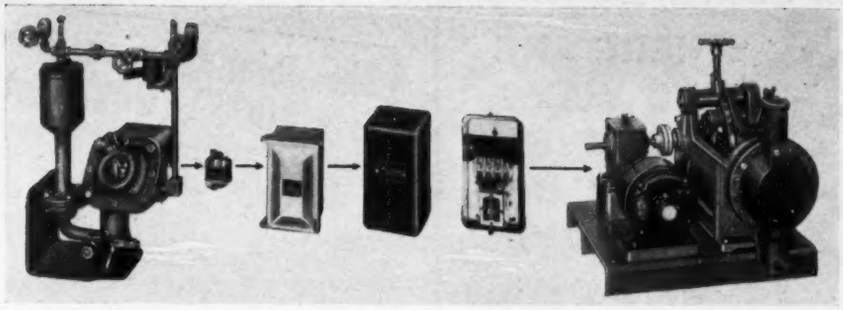

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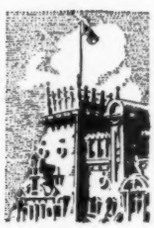

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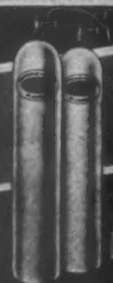

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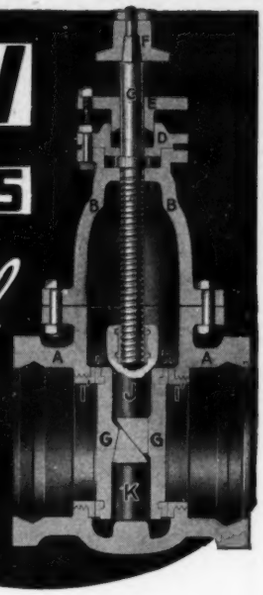

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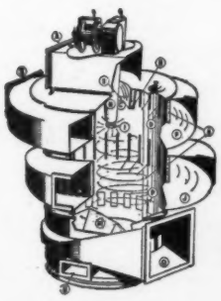

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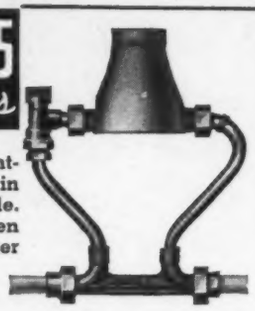

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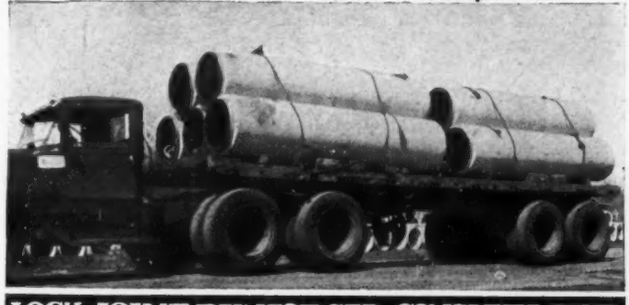

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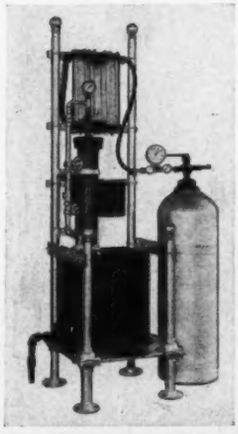

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ADVERTISERS

A

Activated Alum Corp. . . . 64
Alvord, Burdick & Howson. . . . 62
Arrowhead Iron Works. . . . 66
Atlas Mineral Products Co. of Pa., The. . . . 64

B

Bellevue-Stratford Hotel 64
Black & Veatch 62
Bowen Research Corporation. . . . 65
Builders Iron Foundry. . . . 55
Burns & McDonnell Engr Co. . . . 62

C

*Carborundum Company, The. . . . 19
Cast Iron Pipe Research Assoc., The. . . . 22
Chain Belt Company. . . . 4
Chester Engrs., The J. N. . . . 62
*Chicago Bridge & Iron Co. . . . 10
Chicago Pump Company. . . . 18
Chicago Rawhide Mfg. Co. . . . 67
Chicago Testing Laboratory, Inc. . . . 62
Clark Controller Co., The. . . . 3
Columbia Alkali Corp., The. . . . 13
Columbian Iron Works. . . . 67
Corning Glass Works. . . . 7
Crane Co. . . . 15

D

*Dorr Company, Inc., The. . . . Third Cover
Dresser Mfg. Company, S. R. . . . 57

E

*Edson Corporation, The. . . . 66
Electro Bleaching Gas Co. . . . 11
Everson Mfg. Co. . . . 67

F

Faesy & Besthoff, Inc. . . . 65
Ford Meter Box Co. . . . 66
Fuller & McClintock. . . . 62

G

*Golden-Anderson Valve Specialty Co. . . . 60
Graver Tank & Mfg. Co., Inc. . . . 61
*Gruendler Crusher & Pulverizer Co. . . . 67

H

Hellige, Inc. . . . 67
Hill, Jr., Nicholas S. . . . 62
Hills-McCanna Co. . . . 59

I

*Industrial Chemical Sales. . . . 5
*Inertol Company, Inc. . . . 64
*International Filter Co. . . . 60

K

Knowles, Inc., Morris. . . . 62
Koppers Company 8-9

L

La Motte Chemical Products Co. . . . 66
Layne & Bowler, Inc. . . . 63
Lock Joint Pipe Co. . . . 67
Ludlow Valve Mfg. Co., The. . . . 65
Lynchburg Foundry Company. . . . 57

M

Mathieson Alkali Works, Inc., The. . . . 20
Metcalf & Eddy. . . . 62
Monsanto Chemical Company. . . . 64
Mueller Co. . . . 67

N

*National Water Main Cleaning Co. . . . 67
Nichols Engineering Research Corp. . . . 12

P

*Pennsylvania Salt Mfg. Co. . . . 14
*Permutit Company, The. . . . 61
Pirnie, Malcolm 62
Pittsburgh-Equitable Meter Co. . . . Front Cover
Pittsburgh Steel Co. . . . 60
Potter, Alexander 62
Powell, Shepard T. . . . 62
Proportioneers, Inc. . . . 63

R

Reeves Pulley Company. . . . 58
Riddick, Thomas M. . . . 62
Roberts Filter Mfg. Co. . . . 67

S

*Servicised Products Corp. . . . 61
*Simplex Valve & Meter Co. . . . 55
South Bend Foundry Co. . . . 66

U

*United States Pipe & Foundry Co. . . . Second Cover

V

Victor Equipment Company. . . . 65
*Vogt Mfg. Co., Inc. . . . 63

W

*Wallace & Tiernan Co. . . . Back Cover
Water Leak Detector Co. . . . 6
Water Works and Sewerage. . . . 16-17
Whitman & Howard. . . . 62

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In Europe, Spain has replaced Abyssinia as a storm center, with war preparations increasing everywhere and no signs of an early reversal of trends. No nation wants a war or can see a real gain in one, but there is always the danger of a bluff being called.

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Coming from Sweden for our handling, this machine, using a new flotation principle, yields high recovery and direct return of stock to the paper machine.

SOUTH AMERICA

One of our veteran engineers, who went down in '35 on a survey trip and spent a year there, has returned to Buenos Aires to maintain technical contact with our agents in the Argentine and Brazil and with our clients and friends in the rest of South America.

TRADE WASTES

Fourteen bills before Congress. Increased federal regulation seems a sure bet. The experience we've had with dozens of industrial wastes places us in position to help many industries affected.

EUROPE

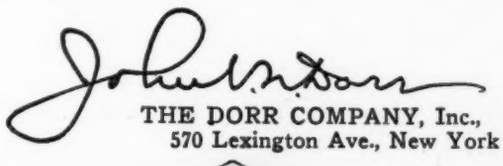
One thinks first only of political conditions—one war over, another most sad still raging—and of increased economic activity, partly due to preparation. Our casualty—one fine young engineer on the Madrid sewage plant job, "missing" since July.

Our work abroad has been most active, including design and equipment for cyanide plants with chemical, oil and paper mill equipment in great demand.

The year has brought me much variety; the building of a small home for ourselves at Westport near the "Mill"; the publication of "Cyanidation"—McGraw Hill '36, with the help of associates and many friends throughout the mining world; conventions in Europe and Mexico, besides the usual "run of the mine" work in a perplexed and troubled age.

"Gang travel" with the Chemical Engineers to meetings and parties at the first World Chemical Engineering Congress in London, as well as a special train to Mexico City with my old crowd—the Min. & Met. Engineers—and the hospitality received everywhere emphasized again the international character of the Engineer, whatever his prefix.

To those fine men, plugging away in all parts of a most puzzled world, and speaking also for my associates here and in the Philippines, Japan, India, the Argentine and Europe, I send most cordial wishes for a Happy and more Clarifying New Year.



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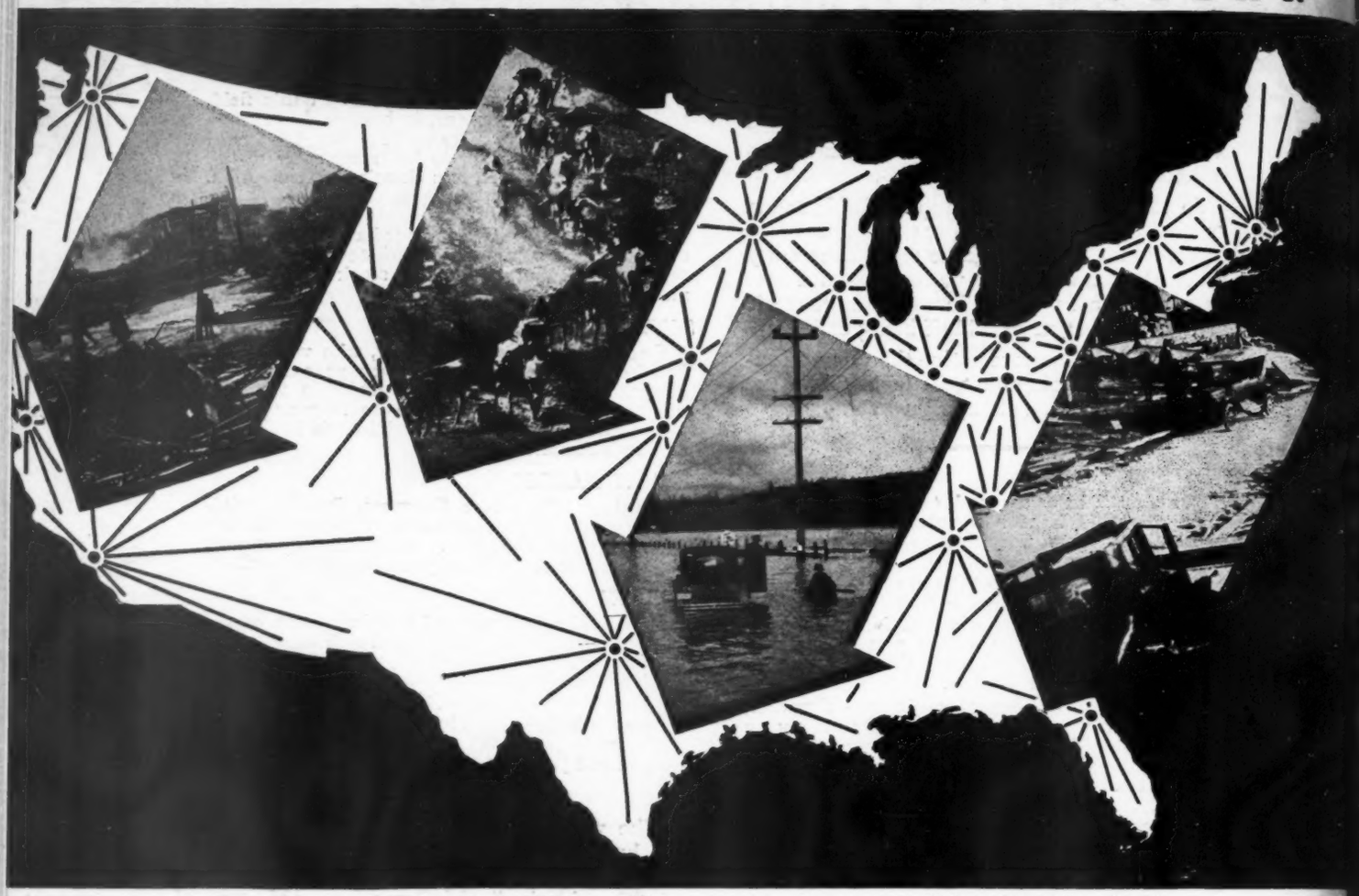
DORRCO

SAVING TOMORROW'S TAX DOLLAR



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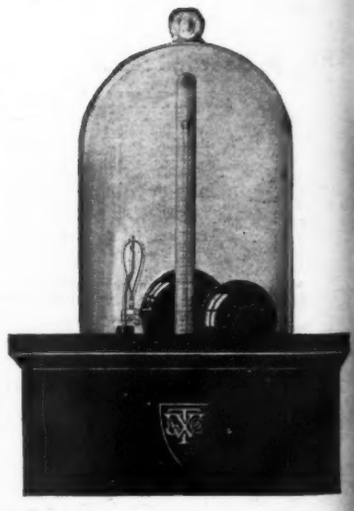
With W & T Visible Vacuum Chlorinators, repair jobs are seldom necessary. But with each installation goes W&T service — prompt, efficient, and ready for your call. Twenty-nine District Offices throughout the land stand ready to prove that each sale is an obligation — each installation another opportunity to do our part in protecting the Public Health.

Provide for tomorrow's need by selecting W & T Visible Vacuum Chlorinators today.



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